Draft Environmental Impact Statement
for

Cyprus Miami Leach Facility Expansion Project
Miami, Arizona

United States
Department of
Agriculture

Forest Service
Tonto National Forest

United States
Department of
Interior

Bureau of Land
Management
Phoenix District

U.S. Army Corps of
Engineers
Los Angeles District

April 1997

United States Department of the Interior
Bureau of Land Management
Phoenix Field District
2015 W. Deer Valley Rd.
Phoenix, AZ 85027
(602) 780-8090

United States Department of Agriculture
Forest Service
Tonto National Forest
2324 E. McDowell Rd.
Phoenix, AZ 85006
(602) 225-5200

3809 (917)
ASA 28631
BLM/AZ/PL-97/003

Dear Reviewer:

This copy of the Draft Environmental Impact Statement (EIS) for the Cyprus Miami Mining Corporation's Proposed Leach Facility Expansion Project is provided for your review and comment. The EIS has been prepared jointly by the U.S. Forest Service (Tonto National Forest) and the Bureau of Land Management (Phoenix Field Office) and is transmitted on behalf of both agencies.

We welcome your participation in the public review process. Those comments addressing the adequacy will be responded to in the final EIS. You should be as specific as possible when preparing your comments. The cover sheet following this letter provides specific information related to the Project, such as comment dates, etc. An Executive Summary is provided in the document itself and gives and overview of the Draft EIS.

Public hearings regarding this draft EIS will be held as follows:

May 14, 1997 - 7:00-9:00 PM	Tri-Cities Fire Station 4280 East Broadway Claypool, AZ 85532
May 15, 1997 - 7:00-9:00 PM	Mesa Community & Conference Center 201 Center Street (Palo Verde 1 Room) Mesa, AZ 85211

All comments should be addressed to either of the co-project managers listed on the cover sheet in the Draft EIS. If you have any questions, you may call them at the following numbers: 1) Forest Service Project Manager, Paul Stewart, (602) 225-5200; or 2) BLM Project Manager, Shela McFarlin, (602) 417-9568.

Sincerely,

Denise P. Meridith
State Director
Bureau of Land Management

and

Charles R. Bazan
Forest Supervisor
Tonto National Forest

Enclosures

COVER SHEET
DRAFT ENVIRONMENTAL IMPACT STATEMENT
CYPRUS MIAMI MINING CORPORATION
LEACH FACILITIES EXPANSION

BLM EIS No.: BLM/AZ/PL/003

Type of Action: (X) Administrative ( ) Legislative

Leading Agencies: U.S. Department of the Interior, Bureau of Land Management
U.S. Department of Agriculture, Forest Service

Cooperating Agency: U.S. Army Corps of Engineers

Project Location: Miami, Arizona

For Further Information/Submit Comments to:

Mr. Paul Stewart, Co-Project Leader
Tonto National Forest
2324 E. McDowell Road
Phoenix, Arizona 85006
(602) 225-5200

Ms. Shela McFarlin, Co-Project Leader
Bureau of Land Management
Arizona State Office (AZ-917)
222 North Central
Phoenix, AZ 85004
(602)417-9568

Comments Must be Postmarked No Later Than: June 10, 1997, or 60 days from publication of Notice of Availability by Environmental Protection Agency.

Date Draft Filed with the Environmental Protection Agency: April 2, 1997

ABSTRACT

This Draft Environmental Impact Statement (EIS) analyzes impacts that may occur from the proposed new facilities to support the continuation of the copper mining operations at Cyprus Miami Mining Corporation's mine in Miami, Arizona. Existing facilities at the mine include: leaching facilities, open pits, solution collection reservoirs, a solvent extraction facility, an electrowinning plant, and waste rock disposal facilities on both private and public lands. The Cyprus Miami complex also includes a smelter, electro-refinery and a rod plant. The smelter complex receives its copper concentrates from off-site sources and is therefore, not associated with operation of the mine. The proposed action includes three new leach facilities and a new waste rock disposal area located on private land and public lands administered by both the BLM and Forest Service. Three alternatives are analyzed in detail in this Draft EIS: The Proposed Action, Alternative A - Modified Development Sequence and the No Action alternative. The Proposed Action and Modified Development Sequence Alternatives would involve approximately 350 acres of BLM-administered land and 420 acres of Forest Service-administered land, and would extend the life of the mine from 16 to 20 years. Total land disturbance associated with the two action alternatives is estimated at 1,057 acres. Alternative A was developed by the joint-agency Interdisciplinary team and proposes construction of the facilities in a different time sequence in order to delay or eliminate impacts to water and biological resources. Alternative A became the Agency Preferred Alternative for these reasons and because a net decrease in air emissions would result. The No Action alternative would involve continued open pit mining operations on private lands with closure in approximately 2018.

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INTRODUCTION

The Forest Service and Bureau of Land Management (BLM) are serving as joint-lead agencies for preparation of this Environmental Impact Statement (EIS) in response to an Operating Plan filed by Cyprus Miami Mining Corporation (Cyprus Miami). The U.S. Army Corps of Engineers (COE), Los Angeles District, is a cooperating agency for purposes of processing a permit under Section 404 of the Clean Water Act.

Cyprus Miami submitted an Operating Plan to the lead agencies proposing construction of three leach facilities and one waste rock disposal facility; this would allow Cyprus Miami to continue copper mining and processing operations at Miami, Arizona for about 16 to 20 years. The Proposed Action includes private lands owned by Cyprus Miami and federal lands administered by the BLM and Forest Service. The site is located in Gila County, located approximately 90 miles east of Phoenix, Arizona.

This Environmental Impact Statement (EIS) has been prepared to document and analyze potential environmental impacts that may result from implementing the Proposed Action and two Alternatives. The EIS is being prepared in accordance with the National Environmental Policy Act (NEPA) and appropriate regulations, manuals and handbooks as described in Chapter 1.

PURPOSE AND NEED

The purpose for the proposed facilities includes the following:

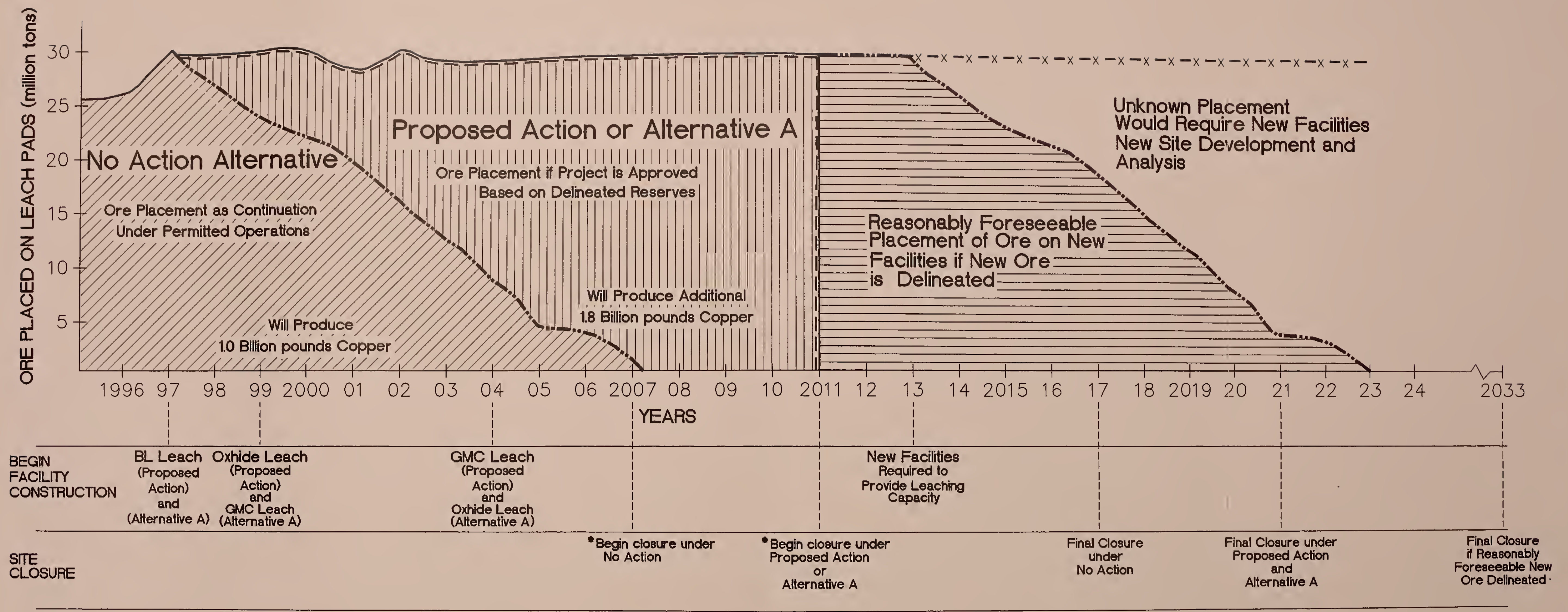
- Recovering as much of the identified mineral deposit as possible,
- Meeting the spatial and capacity requirements for 29 million tons of ore per year (maintaining the current level of production),
- Operating in an economic manner,
- Maintaining the work force of approximately 950 people,
- Recouping the corporation's investment,
- Continuing use of the existing facilities, and
- Helping meet market demands for copper.

ALTERNATIVES

Three alternatives are analyzed in this document. **Table S-1** compares the alternatives and **Figure S-1** provides a graphic representation of all alternatives. The three alternatives are briefly discussed below.

No Action Alternative

Under the No Action Alternative Cyprus Miami, would continue mining and placing ore on existing facilities until these facilities reached their full capacities. No new ground disturbance would occur on federal lands outside of existing permitted operations. No new infrastructure would be constructed.



*Note: After ore placement ceases, There would be o period of residual copper recovery through recirculation of leaching solution until no longer economicol. Final site closure would ocuur ofter residual copper recovery (opproximotely 10 yeors).

Rev. 3/27/97

Source: Cyprus Miomi Mining Corporation

Cyprus Miami Mining Corporation
Leach Facility Expansion EIS

Figure S-1

COMPARISON OF ALTERNATIVES FOR
- ORE PLACEMENT
- CONSTRUCTION OF FACILITIES
- MINE CLOSURE

GREYSTONE

Existing leach capacity would allow ore placement to peak at 29 million tons in 1997, then decline steadily until capacity is reached in 2007. At that time, mining and ore placement would cease. The No Action Alternative would have an average production rate of 17 million tons per year, slightly more than half the production rate of the Proposed Action. Leaching of residual copper placed on these existing facilities would continue for approximately 10 years beyond the final ore placement. Total amount of copper recovered under this alternative would be approximately one billion pounds, with known ore reserves left in place and perhaps not developed.

Work force reductions would begin as early as 1998 and total 383. Site closure would begin in 2007 and be completed in 2017. Reclamation would be completed in 2022.

Proposed Action

The Proposed Action consists of the following:

- Construction of three new leach facilities: Oxhide, BL and GMC. The leach facilities would be used for placement and subsequent leaching of copper-bearing ore mined from reserves located on lands owned by Cyprus Miami. Material placed on the lined leach pads would be rinsed with sulfuric acid solutions; the resulting copper-bearing solution would be collected and treated at the existing solvent extraction and electro-winning plants to produce high quality cathode copper.
- Construction of the Barney waste rock disposal facility. The waste rock disposal area would be used to place the uneconomic or non-mineralized material removed from the mining pits.
- Necessary ancillary facilities such as access/haul roads, solution pipelines, and surface water control structures.

The proposed project would support the continuation of an existing level of operations at the Cyprus Miami Mine for an estimated 16 to 20 years (the end of the current planning cycle and mining of currently delineated reserves). Development of the new leach facilities would enable continuous ore placement at an average annual rate of 29 million tons through 2011.

Work force reductions would start in 2008. Site closure would begin in 2011 and be completed in 2021. Reclamation would be completed in 2026.

Alternative A—Modified Development Sequence (Agency Preferred Alternative)

Alternative A is identical to the Proposed Action with one important difference: the order of construction of the Oxhide and GMC leach facilities is reversed. As **Table S-1** and **Figure S-1** shows, this means that the Oxhide leach facility would be constructed last. Alternative A was developed by the joint agency Interdisciplinary Team in order to delay or avoid disturbance of environmental resources at the proposed Oxhide leach site; these resources include two ponds (one of which contains longfin dace), two reaches of willow riparian habitat, and extensive oak chaparral. Construction of the Oxhide facility may not be needed if (1) the historic Webster Lake area becomes legally available for permitting (see discussion in Sections 2.5, 2.7.5, and

3.3.2.2), or (2) improvements in copper leaching and recovery technology render a third leaching facility unnecessary. This alternative was preferred by the agencies because it would result in delayed and possibly eliminated, impacts to certain resources (water and biological), and because it provided a net decrease in air emissions.

SCOPING & ISSUES

The lead agencies have solicited public participation through a scoping process according to the provisions of NEPA and included scoping meetings, public notices, and mailing of letters to approximately 890 addresses.

A detailed listing of issues identified during scoping is presented in Section 1.6 of the EIS.

Issues determined to be affected are discussed in detail in Chapter 3; issues determined not to be affected are also identified in Chapter 3. Resources which are affected are analyzed in detail in Chapter 4.

SUMMARY COMPARISON OF ALTERNATIVES AND IMPACTS

Table S-1 is a comparison of facilities and operations by alternative. **Figure S-1** is a graphic representation of the three alternatives and their components (ore placement, construction of facilities and mine closure). **Table S-2** shows the comparison of impacts by alternative.

Table S-1. Summary Comparison of Facilities and Operations by Alternatives

Project Element	No Action	Proposed Action	Alternative A (Modified Development Sequence)
Ore Placement	Until 2007 @ 10% reduction per year Total = 263 million tons[2]	Until 2011 or beyond[1] @ 29 million tons/yr Total = 487 million tons[3]	Same as Proposed Action
New Leach Facilities	No new facilities on public land.	BL 1997[4] Oxhide 1999 GMC 2004	BL 1997[4] GMC 1999 Oxhide 2004
Waste Rock Placement	Until 2007 with a 10% reduction each year. Total = 832 million tons[6]	Until 2011 or beyond[1] @ 62 million tons/yr Total = 906 million tons[5]	Same as Proposed Action
New waste rock facilities constructed on public land	None	Barney 1997	Same as Proposed Action
Acres of disturbance on public land	None	771	Same as Proposed Action
Copper Recovery during Mining	55 million lbs/yr through 2007. Total 55 million lbs.	160 million lbs/year through 2011. Total 1.45 billion lbs.	Same as Proposed Action
Copper Recovery - Residual (post-mining)[7]	10 million lbs/yr from 2008 to 2017. Total 90 million lbs.	10 million lbs/yr from 2012 to 2021. Total 90 million lbs.	Same as Proposed Action
Site Closure	Leach facility closure begins 2007. Final leach facility closure: 2017. Residual copper production until 2017.[7] Final reclamation completed 2022.	Leach facility closure begins 2011.[8] Final leach facility closure: 2021 Residual copper production until 2021.[7] Final reclamation completed: 2026	Same as Proposed Action

1 The information in this table represents no further mining after the expansion under the Proposed Action. However, it is reasonable to assume that Cyprus Miami will identify minable reserves in the area and will continue operations beyond this proposed expansion project.
2 Denotes total volume of ore that can be placed on existing facilities on Cyprus Miami lands.
3 Denotes total ore that can be placed on private and public land as a result of approval of the Proposed Action.
4 Denotes year construction begins.
5 Denotes total waste rock that can be placed on private and public land as a result of approval of the Proposed Action.
6 Denotes total waste rock that can be placed on existing facilities on Cyprus Miami lands.
7 Leach facility closure involves a ten-year period of heap leach solution recirculation which allows for residual copper production up to ten-million tons/year following final placement of ore.
8 If new ore is delineated, all site closure dates for the Proposed Action and Alternative A could be delayed.

Table S-2. Summary Comparison of Impacts By Alternative

Environmental Resource	Indicator (Units)	No Action Alternative	Proposed Action	Alternative A - Modified Development Sequence (Agency Preferred)
Air Resources	Particulate Matter (PM_{10}) (p. 4-13)	3,778 tpy, starting to decrease in 1997.	662 tpy more than No Action	140 tpy less than No Action, source at Oxhide delayed 7 years.
	Sulfur and Nitrogen Oxides (SO_x-NO_x) (p. 4-19)	3660 tpy, starting to decrease in 1997.	910 tpy SO_2- NO_x more than No Action	166 tpy SO_2-NO_x less than No Action
	Acid Mist (p. 4-20)	Negligible	Negligible	Same as proposed
	Hazardous Air Pollutants (p. 4-19)	3.3 tpy	3.35 tpy	Same as proposed
	Conformity Analysis Requirement	Not applicable as already permitted	Full analysis would be needed if selected	Analysis not needed as emissions below threshold
Geology and Minerals	Slope Stabilities (p. 4-25)	Sufficient safety factors	Sufficient safety factors	Same as proposed
	Mineral (Copper) Production (p. 4-25)	55 million lbs/yr 1.0 billion lbs recovered total	160 million lbs/yr 2.8 billion lbs recovered total	Same as proposed
Groundwater	Quantity (p. 4-27)	No change	Depth to groundwater may increase adjacent to the BL pit. No other significant impacts.	Same as proposed
	Quality (p. 4-28)	On site exceedances of AZ standards for SO_2, TDS, Al, Fe, Mn, Cl, Cd, Cr, pH, and radionuclides.	Possible exceedence of aquifer water quality standards (AWQS) for a short distance down-gradient of leach facilities. No other significant impacts.	Same as proposed; no change at Oxhide site for 7 years.
Surface Water	Quantity (p. 4-33)	No change from current conditions.	Current drainage patterns altered. 16 water sources would be covered by the proposed facilities. No other impacts. Surface water contained on-site.	Same as proposed, no change at Oxhide site for 7 years.
	Quality (p. 4-35)	No change from current conditions.	Minimal impacts. Surface water contained on-site.	Same as proposed.

Environmental Resource	Indicator (Units)	No Action Alternative	Proposed Action	Alternative A - Modified Development Sequence (Agency Preferred)
	Water rights (p. 4-37)	No change from current conditions.	Amendment or loss of water rights associated with water sources covered by the proposed facilities.	Same as proposed
	Waters of the United States (p. 4-37)	No change from current conditions.	Loss of 9.22 acres of open water, drainages, and wetlands.	Same as proposed; a pond, wetland, and drainage at Oxhide not disturbed for 7 years.
	Springs, Seeps and Ponds (4-35)	No change from current conditions.	8 ponds or tanks lost, 7 springs or seeps lost	Same as proposed, 3 ponds and 1 seep at Oxhide not disturbed for 7 years.
Soils and Reclamation	Acres disturbed (p. 4-40)	151	1,057	Same as proposed
	Salvageable topsoil (p. 3-49)	Unknown	512,884 cubic yards	Same as proposed
	Estimate of reclamation success	Revegetation plan is approved. Revegetation and stabilization of various areas.	Revegetation of 272 acres. Various stabilization on about 785 acres.	Same as proposed
	Soil Loss (p. 4-41)	5.4 tons/acre. Total 30,400 tons.	6.9 tons/acre. Total 7,300 tons.	Same as proposed
Vegetation	Acres lost (p. 4-44)	151	1,057	Same as proposed
	Sensitive species affected (p. 4-43, 4-44, 4-45)	No new disturbance	7 acres of Riparian vegetation lost 0.06 acres of Wetlands lost	Same as proposed, loss of wetland at Oxhide delayed 7 years. (1.53 acres)
Wildlife	Populations displaced (p.4-47)	No new disturbance	No habitats designated crucial or important	Same as proposed
	BLM or FS Sensitive species affected (P. 4-48)	No new disturbance	From 0 to 14 percent of available habitat affected. No federally-listed T & E species affected. Dace population lost. Some leopard frogs lost.	Same as proposed, Dace population not affected for 7 years.
	Federally-listed T&E species: (p. 4-48)	No new disturbance	None affected.	Same as proposed
Cultural Resources	Sites affected (p. 4-53)	Potential effect to resources on private land.	32, mitigated by treatment plan.	Same as proposed

Environmental Resource	Indicator (Units)	No Action Alternative	Proposed Action	Alternative A - Modified Development Sequence (Agency Preferred)
Socioeconomics	Population (p. 4-58)	0.8 percent decrease.	No change from current.	Same as proposed.
	Changes in Employment[1] (p. 4-59)	425 total positions (309 mine & leach; 116 SX-EW). 10% reduction each year from 1998 to 2007. Workforce in 2007=42.	425 total positions. 10% reduction each year from 2008 to 2011. Workforce in 2011=85.	Same as Proposed Action
	Environmental Justice (p. 4-59)	Hispanic population disproportionately affected by workforce reduction.	No change from current.	Same as proposed.
	Tax Revenues (p. 4-61, 4-63)	$577.1 million to Gila County.	$1.1 billion to Gila County.	Same as proposed.
	Demand for Public Services (p. 4-63)	Slight reduction.	No change from current.	Same as proposed.
Land Use	Compliance with plans and permits (p. 4-64)	In compliance	In compliance	Same as proposed
	Public road closures (p. 4-67)	No effect	Forest Road 608 closed	Same as proposed
Visual Resources	Comply with VQO (p. 4-70)	In compliance	In compliance	Same as proposed. Oxhide visibility from Hwy. 60 delayed 7 years
	Views from KOP (p. 4-71)	No effect	Not significant	Same as proposed
Hazardous Materials	Spill and Exposure Potential (p. 4-73	No change	Minor increase	Same as proposed

[1] Workforce reduction estimates are based on the 17 year mine plan submitted by Cyprus Miami, which is based on currently delineated reserves. If new ore reserves are delineated, the start of workforce reductions would be delayed by an unknown number of years based on the amount of new ore reserves (see **Figure S-1** for visual depiction of area of possible new ore).

Issue Tracking Matrix - Page Numbers Where Issues Are Addressed

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4. Surface Water Flows	S-4, S-6, S-7	1-6, 1-12	2-17, 2-18, 2-20, 2-22, 2-26, 2-34, 2-35	3-34, 3-37, 3-38, 3-45	4-28, 4-31, 4-33, 4-69, 4-79
5. Air Quality	S-6	1-6, 1-7, 1-10, 1-12	2-34	3-2	4-3, 4-5, 4-68
6. Geotechnical Stability	S-6	1-7, 1-12	2-11, 2-15, 2-34	3-21	4-7, 4-19
7. Soil Losses	S-7	1-10, 1-12	2-35	3-45	4-8, 4-36, 4-81
8. Reclamation Potential	S-7	1-12	2-5, 2-27, 2-28, 2-29, 2-35, 2-40		
9. Sensitive Plants	S-7	1-6, 1-10, 1-12	2-35	3-59, 3-60, 3-61	4-39, 4-40, 4-69, 4-78, 4-81
10. Wetlands	S-5	1-6, 1-8, 1-10, 1-12	2-31, 2-36	3-58, 3-59	4-40, 4-70, 4-84
11. Wildlife Habitats	S-2, S-7	1-6, 1-7, 1-8, 1-10, 1-12	2-35, 2-38, 2-39	3-62	4-9, 4-42, 4-78, 4-81
12. Sensitive Wildlife	S-7	1-6, 1-10, 1-12, 1-13	2-31, 2-35	3-66, 3-67, 3-68	4-4, 4-43, 4-44, 4-69, 4-80
13. Cultural Resources	S-7	1-6, 1-8, 1-10, 1-13	2-35	3-69	4-48, 4-80, 4-82
14. Job Preservation	S-1, S-2, S-8	1-4, 1-7, 1-10, 1-13	2-35, 2-37	3-80	4-11
15. Support of Economy	S-8	1-6, 1-10, 1-13	2-36	3-80, 3-85	4-12, 4-12, 4-53
16. Land Use Changes	S-5, S-8	1-9, 1-10, 1-13	2-18, 2-22, 2-24, 2-33, 2-36	3-90	4-58, 4-69, 4-78, 4-80, 4-82
17. Recreation Changes		1-10, 1-13	2-7	3-2	4-3
18. Visual Resources	S-8	1-10, 1-13	2-44	3-98	4-4, 4-64, 4-69, 4-79, 4-82
19. Noise		1-10, 1-13		3-12	
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1.0 INTRODUCTION, PURPOSE, AND NEED

1.1 INTRODUCTION

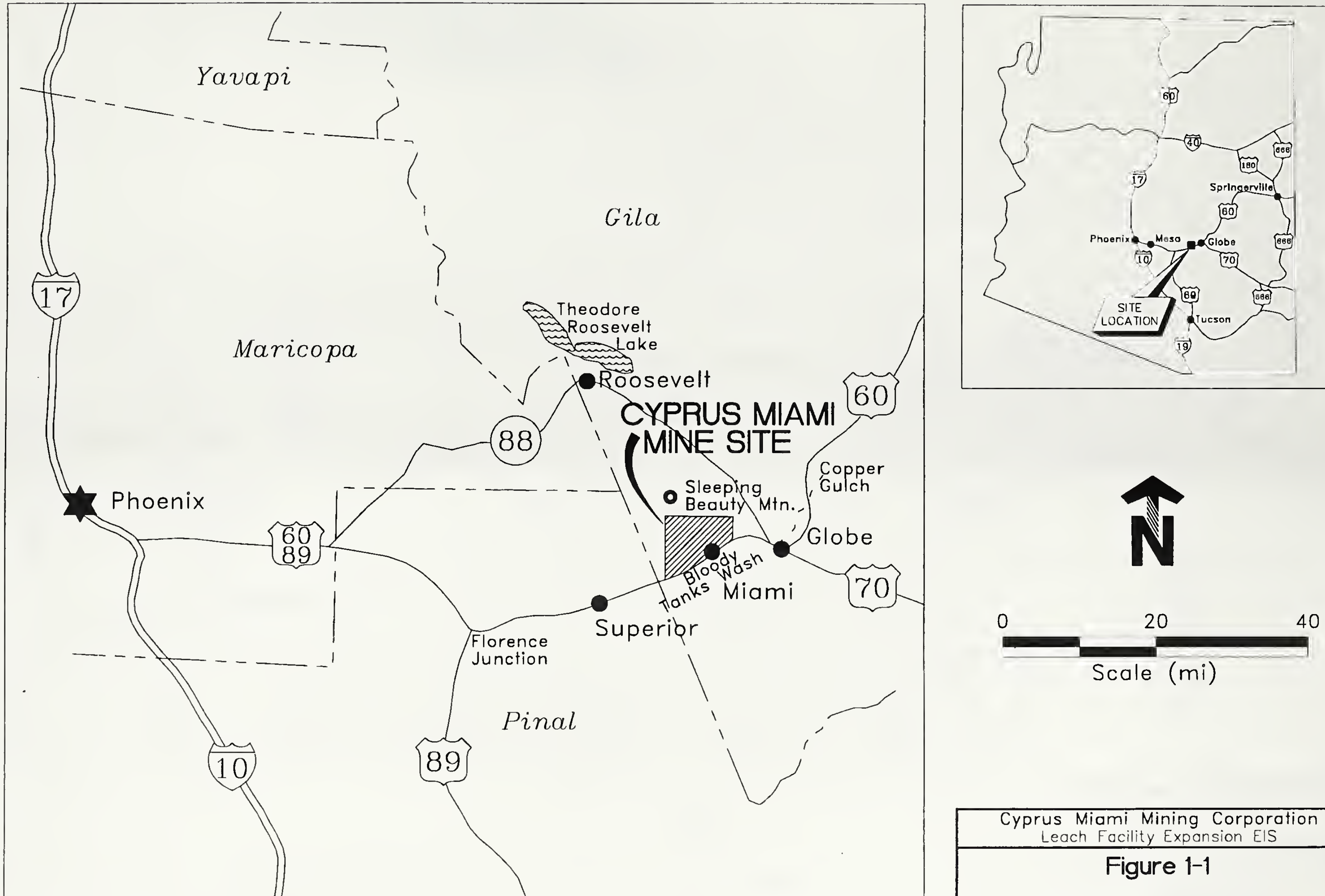
In April 1994, Cyprus Miami Mining Corporation (Cyprus Miami) filed an Operating Plan with the Tonto National Forest (Forest Service) and the Bureau of Land Management (BLM) - Phoenix Field Office. (Forest Service refers to this as a Plan of Operations and BLM refers to it as a Mining Plan of Operations, but for consistency, it is referred to as the Operating Plan throughout this document.) This Draft Environmental Impact Statement (DEIS) analyzes the Operating Plan with final revisions dated March 19, 1997. The Operating Plan outlines the proposed expansion of copper ore leaching facilities at Cyprus Miami's mining operations northwest of the town of Miami in Gila County, Arizona (**Figure 1-1**). The proposed project includes development of three leach pad facilities, one waste rock disposal site, and associated facilities including haul roads and surface water diversions, which connect with existing facilities (**Figure 1-2**). The proposed facilities are immediately adjacent to the existing Cyprus Miami mine. BLM has assigned the Operating Plan case file number AZA-28631 in their serialized case recordation system.

This chapter describes the purpose of and need for the proposed leach facility expansion, the role of the joint-lead agencies, the U.S. Army Corps of Engineers (COE) as a cooperating agency, and public participation in the EIS process. Chapter 2 describes the proposed action and its relationship to existing mining and processing facilities at the site as well as identifying and describing reasonable alternatives to the proposed action. Chapter 3 describes the human and physical environmental resources that may be affected by development of the proposed action or the alternatives. The direct, indirect, and cumulative impacts anticipated as a result of the proposed action or the alternatives are described and evaluated in Chapter 4 along with proposed mitigation measures to minimize or alleviate these impacts. Chapter 5 describes and documents the consultation and coordination with various agencies and the public during the EIS process. Chapter 6 provides a listing of the individuals responsible for preparing various sections of the EIS. Chapter 7 includes a list of references cited in the document, and a glossary of terms is provided as Chapter 8.

1.2 PURPOSE AND NEED

Cyprus Miami is in the business of mining copper ore and recovering copper metal in the Miami, Arizona area. The corporation wishes to continue this activity and has submitted an Operating Plan to the BLM and Forest Service. The Corporation's purpose is to gain exclusive use of federal lands where they have mining claims. The purpose of this EIS document is to assist the BLM and Forest Service decision-makers on how best to implement the proponent's Plan of Operations.

Cyprus Miami needs exclusive use of the federal lands for construction of three leach facilities and one waste rock disposal facility for an estimated period of 16 to 20 years. The need for these facilities includes:

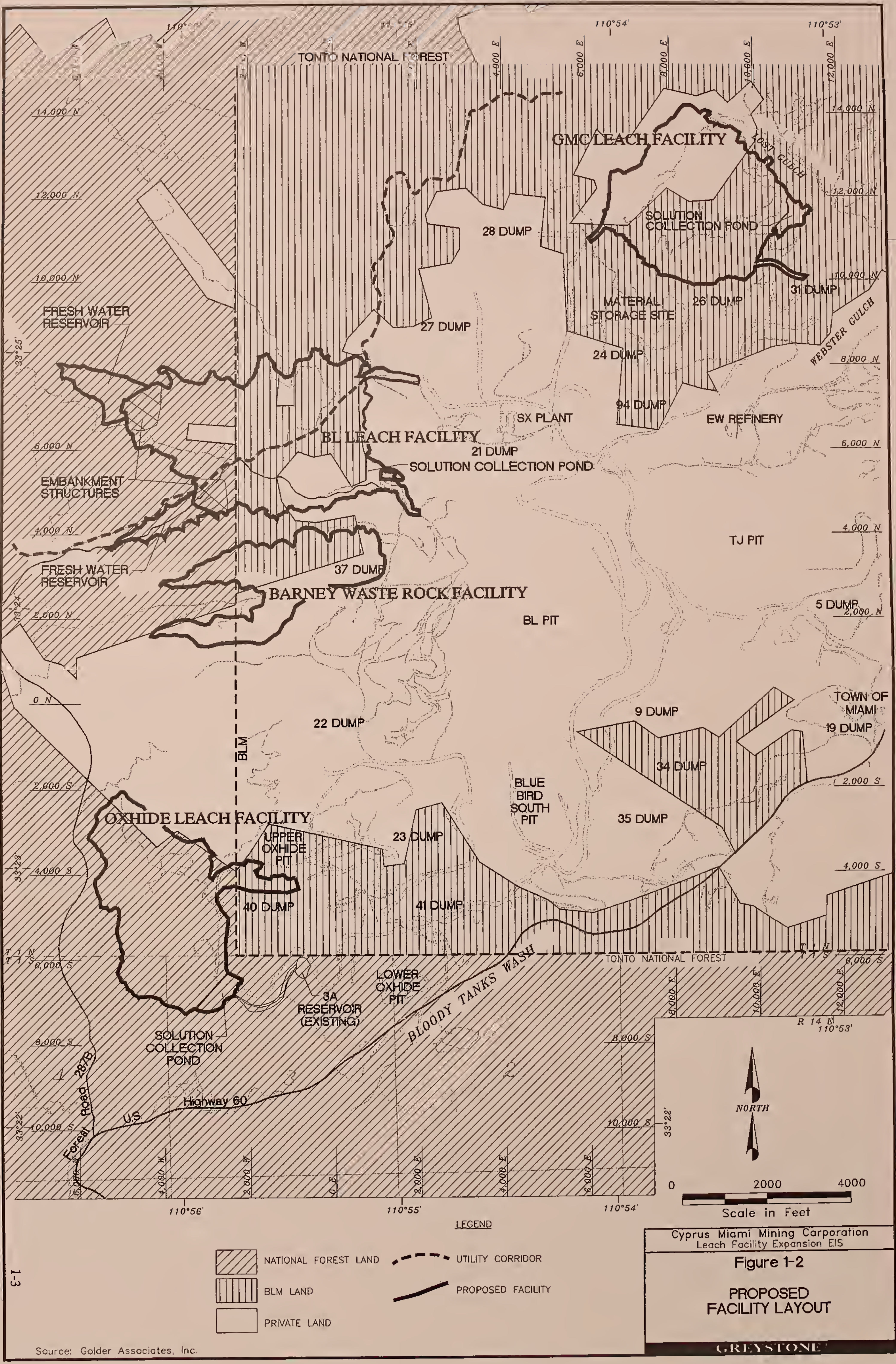


Cyprus Miami Mining Corporation
Leach Facility Expansion EIS

Figure 1-1

SITE LOCATION MAP

GREYSTONE®



Source: Golder Associates, Inc.

- Recovering as much of the identified mineral deposit as possible,
- Meeting the spatial and capacity requirements for 29 million tons of ore per year (maintaining the current level of production),
- Operating in an economic manner,
- Maintaining the work force of approximately 950 people,
- Recouping the corporation's investment,
- Continuing use of the existing facilities, and
- Helping meet market demands for copper.

The purpose and need of this project, in accordance with the guidelines pursuant to Section 404(b)(1) of the Clean Water Act, must be defined due to impacts to waters of the United States that would occur as a result of the proposed project. The basic project purpose is to mine and process copper, the overall project purpose is to extend the mine life by continuing to mine copper at the existing Cyprus Miami facilities and to process the mined copper using the existing solvent extraction/electro-winning (SX/EW plants) facilities.

Development of the proposed facilities would occur on a combination of public and private lands. The public lands include lands managed both by the Tonto National Forest and the Phoenix Field Office of the BLM as shown on **Figure 1-2**. In accordance with the National Environmental Policy Act of 1969 (NEPA), both the BLM and Forest Service have reviewed the Operating Plan and determined that since the proposed project could potentially result in significant environmental impacts, an Environmental Impact Statement (EIS) would be necessary. Preparation of this document follows Council of Environmental Quality (CEQ) regulations under NEPA (Title 40 Code of Federal Regulations [CFR] Parts 1500-1508), BLM regulations at 43 CFR 3809, Forest Service regulations at 36 CFR 228, the BLM Arizona Environmental Handbook (Arizona State Office H-1790-1), the BLM NEPA Handbook (H-1790-1), the Forest Service Manual (Chapter 1950), and the Forest Service Environmental Policy and Procedures Handbook (Handbook 1909.15).

1.3 AUTHORITIES AND DECISIONS TO BE MADE

1.3.1 Authorities

Under provisions of the U.S. mining laws (30 United States Code [U.S.C.] 21-54), the holder of valid mining claims has the statutory right to enter and use such lands for prospecting, exploring, developing, or processing mineral resources in accordance with applicable regulations. The Forest Service, under provisions of 36 CFR Part 228 (Subpart A—Locatable Minerals), is charged with reviewing the proposed Operating Plan for mineral development and ensuring that such operations are conducted in a manner to "...minimize adverse environmental impacts on National Forest System surface resources" (36 CFR 228.1). The BLM, under provisions of 43 CFR Subpart 3809 (Surface Management Regulations), is similarly charged to "prevent unnecessary or undue degradation and provide protection of non-mineral resources of the Federal lands" (43 CFR 3809.0-2). The U.S. Army Corps of Engineers (COE) has

responsibility under Section 404 of the Clean Water Act (33 U.S.C. 1344) for administering regulations related to protection of wetlands and navigable waters of the United States. These regulations are detailed in 33 CFR Parts 320 through 330 and include the issuance of permits for structures and activities affecting navigable waters of the U.S. **Table 1-1** lists authorities of BLM and Forest Services as well as other applicable federal, state and local laws and regulations to which this action would be subject.

1.3.2 Decisions

The Operating Plan submitted by Cyprus Miami describes the proposed action. The decision to be made by BLM and Forest Service is to approve or modify the proposed Operating Plan based on an analysis of impacts. The decision to be made by the COE is to approve or deny an individual Section 404 permit under provisions of 33 CFR Parts 323 and 325. The purpose of the EIS is to provide a full and fair discussion of significant environmental impacts and to inform the decision makers and the public of the reasonable alternatives which would reduce or avoid adverse impacts or enhance the quality of the human environment. An EIS is not a decision document. The BLM and Forest Service will be publishing separate Records of Decision after completion of the Final EIS. Plan approval is also subject to the submittal of an acceptable reclamation bond by Cyprus Miami to the required federal and state agencies.

1.3.3 Agency Coordination

Forest Service and BLM are serving as joint-lead agencies for preparation of this EIS. The COE, Los Angeles District, is a cooperating agency for purposes of processing a permit under Section 404 of the Clean Water Act and analysis of impacts to jurisdictional waters of the United States and wetlands. Other federal and state agencies participating in development of the EIS and their areas of jurisdiction include:

- U.S. Environmental Protection Agency (EPA), Region IX—air quality, water quality, and hazardous materials
- U.S. Fish and Wildlife Service (USFWS)—migratory birds, and threatened and endangered species
- Arizona Department of Environmental Quality (ADEQ)—air quality and water quality
- Arizona Game and Fish Department (AGFD)—wildlife and habitat.
- Arizona Department of Agriculture (ADA)—native plant protection laws.
- Arizona Department of Water Resources (ADWR)—dam safety, water rights, well registration permits.
- Arizona State Mine Inspector—mine safety, reclamation.

TABLE 1-1
ENVIRONMENTAL REGULATORY REQUIREMENTS
(Page 1 of 3)

Authorizing Agency	Law or Regulation	Type of Permit/ Approval/Action/Constraint
US Department of Agriculture, Forest Service, US Department of Interior, Bureau of Land Management	— 1872 Mining Law as amended, 36 CFR 228 and 43 CFR 3809	— Plan of Operations (FS) Filing of claims, Mining Plan of Operations (BLM)
	— National Materials & Minerals Policy, Research and Development Act of 1980 (30 USC 1601—1605)	— Minerals Management (BLM)
	— National Environmental Policy Act of 1969 (NEPA)	— Record of Decision for Approval of Operating Plan
	— National Historic Preservation Act (NHPA) of 1966 as amended	— Cultural Resources Data Recovery Plan — Native American Consultations
	— Archaeologic Resources Protection Act (ARPA) of 1979	— Cultural Resources Mitigation Native American Consultations
	— Native American Graves Protection and Repatriation Act	— Protection of remains and Funerary objects — Native American Consultations
	— Executive Order 11987	— Introduction of Exotic Organisms
	— Executive Order 11988	— Floodplain management
	— Executive Order 11990	— Protection of Wetlands
	— Executive Order 12898	— Environmental Justice in Minority Populations and Lower Income Populations
	— National Forest Management Act	— Maintenance of Viable Species Populations (FS)
	— Endangered Species Act	— Biological Assessment and Consultation with USFWS
	— Migratory Bird Treaty Act of 1918	— Protection of Migratory Birds
	— Clean Air Act	— Conformity Evaluation
U.S. Army Corps of Engineers	— Clean Water Act	— Section 404 Permit
U.S. Fish & Wildlife Service	— Endangered Species Act	— Section 7 Consultation, if necessary (Biological Opinion)

TABLE 1-1
ENVIRONMENTAL REGULATORY REQUIREMENTS
(Page 2 of 3)

Authorizing Agency	Law or Regulation	Type of Permit/ Approval/Action/Constraint
	— Fish & Wildlife Coordination Act	— Consultation on Clean Water Act Section 404 Permit
U.S. Environmental Protection Agency	— Clean Water Act	— Section 402 National Pollutant Discharge Elimination System (NPDES) — Stormwater Discharge Permit — Section 401 Spill Prevention Control and Countermeasures Plan
	— Clean Air Act	— State Implementation Plan (SIP) [pending—will be administered by ADEQ], conformity regulations
Arizona Department of Agriculture	— Native Plant Law	— Salvage or Removal Permit
Arizona Department of Environmental Quality	— Arizona Revised Statutes	— Aquifer Protection Permit
	— Clean Water Act	— Section 401 Water Quality Certification — Spill Prevention Control and Countermeasure Plan
	— Arizona Revised Statutes	— Water Quality Standards
	—	— Air Quality Permits to Install & Operate
	— Hayden Area (SIP) (pending)	— Conformity with SIP
	— Arizona Ambient Air Quality Guidelines	— Toxic Air Pollutants Standards
	— State Reclamation Act	— Mine Reclamation Plan
Arizona Department of Water Resources	— Arizona Revised Statutes	— Well Registration, Surface Water Rights, Dam Safety Regulations
Arizona Game and Fish Department	— Arizona Revised Statutes	— Management and Protection of Wildlife
	— Fish and Wildlife Coordination Act	— Coordination with USFWS; Consultation on Clean Water Act Section 404 Permit

TABLE 1-1
ENVIRONMENTAL REGULATORY REQUIREMENTS
(Page 3 of 3)

Authorizing Agency	Law or Regulation	Type of Permit/ Approval/Action/Constraint
Arizona State Historic Preservation Office	— National Historic Preservation Act	— Cultural Resources Consultation with FS, BLM, and COE plans & mitigation
All State Agencies	— State Executive Order 89-16	— Protection of Streams and Riparian Resources
	— State Executive Order 91-6	— Protection of Riparian Areas
Gila County	— County Ordinances	— Zoning Ordinances, Building Permits

1.4 PROPOSED ACTION

The Proposed Action involves the construction of three new leach facilities with associated haul and access roads, leach solution storage and transfer facilities, and runoff diversion structures. A new waste rock disposal site would also be constructed with haul roads connecting it to existing roads. The project also requires the relocation of an existing, privately-owned utility corridor.

Construction of the leach pads would involve cutting, filling, and leveling the pad area to construct an engineered foundation fill, required because the proposed sites are in complex terrain. A composite, geomembrane liner system (synthetic liner system) would be constructed on the engineered foundation fill. Copper-bearing ore would be placed on the synthetic liner and treated with sulfuric acid (leach solution) to dissolve the copper minerals. The leach solution would drain off the synthetic liner and be captured in drains and a synthetic-lined leach solution reservoir. From the reservoir, the solution would be piped to existing solvent extraction and electro-winning facilities where the copper metal would be extracted from solution.

The waste rock disposal site would be constructed to accommodate uneconomic material removed from the active mining operation. All facilities would operate for the life of the mine, which is estimated to be 16 to 20 years.

The Proposed Action would be located immediately adjacent to the existing Cyprus Miami operations north and west of the town of Miami, Arizona (**Figure 1-1**), in the Pinal Creek drainage. The steep topography, limited access, and proximity to active mining operations generally limit public activities on and uses of the public lands potentially affected by the project. Elevations on the project site range from approximately 3,200 to 5,465 feet above mean sea level (ft-above msl). The proposed sites for the leach facilities expansion are located in the Needle Creek (Oxhide Leach Facility), Barney Canyon (Barney Waste Rock Deposition Facility), Webster Gulch (BL Leach Facility), and Lost Gulch (GMC Leach Facility) drainage basins. The ancestral drainages were tributaries to Bloody Tanks Wash and Miami Wash. Past mining activities have interrupted the tributary drainages so that stormwater runoff from all the affected watersheds is now captured in existing mining pits or other impoundments.

1.5 ENVIRONMENTAL REVIEW PROCESS

1.5.1 Conformance to Existing Land Use Plans

Managment decisions for land uses on public lands administered by both the Forest Service and BLM are guided by their respective land use and management plans (USDA Forest Service 1985a and USDI BLM 1988).

Management activities in both plans for the proposed project area are identified as mining, grazing, wildlife, and recreation. Mining is an authorized and supported use on both the Forest

Service and BLM-administered lands and is consistent with the Gila County policies for public lands. Therefore, mineral resource development is in conformance with the agency's plans cited above.

1.5.2 Public Review Process

The Forest Service and BLM encouraged the public to participate in the environmental review of the Cyprus Miami Leach Facility Expansion Project throughout the EIS process. On October 28, 1994, the agencies published in the *Federal Register* a Notice of Intent to prepare an EIS, inviting public participation in the scoping process. Scoping letters were mailed to approximately 890 individuals and organizations. In addition, two public scoping meetings were held on November 16 and 17, 1994 in Claypool and Mesa, Arizona, respectively. Attendance at the two meetings was 87 and 50 persons, respectively. In total, 48 written letters or comment forms were received during the public scoping period, which ended December 17, 1994.

The regional public agencies, and private organizations contacted during the public scoping process are identified in **Table 5-1** in Chapter 5.

The agencies developed and implemented a Public Affairs Plan to involve the public in the development and review of the EIS. Public participation opportunities included: (1) public scoping meetings; (2) distribution of information on the Cyprus Miami Leach Facility Expansion Project through scoping notices and a Scoping Report; and (3) distribution of this Draft EIS and solicitation of public comments. As part of the scoping effort to contact minority and low-income communities, notices were sent to regional Indian Tribes and local agencies (**Table 5-1**). In addition, a Spanish version of the fact sheet was prepared and posted in public locations in the Globe-Miami area. Following issuance of the Draft EIS, public hearings will be held to accept oral and written comments on the document.

1.6 ISSUES IDENTIFIED DURING SCOPING

Issues and comments from public scoping meetings, mailings, and agency comments fell into these general categories: Groundwater, Surface Water, Air Resources, Geology and Minerals, Soils and Reclamation, Vegetation and Wetlands, Wildlife, Special Status Species, Cultural Resources, Social and Economic Issues (including environmental justice in relation to minorities and low income groups adjacent to the proposed action and the publics that would be affected), Land Use, Recreation, Wilderness and Scenic Rivers, Visual Resources, Noise Generation, Transportation, and Hazardous Materials. In some cases, issues raised were determined by the Interdisciplinary Team to be minor issues not needed to be carried through analysis, and these are denoted in **Table 1-2**. Detailed issue statements are presented in **Table 1-2**. The analysis of direct, indirect, and cumulative impacts on these issues is presented in Chapter 4.

In addition to the issues identified during scoping, it is the policy of federal agencies to ensure that decisions consider the impacts on minority populations and low income communities, as well

as the equity of the distribution of benefits and risks of those decisions. These issues are termed environmental justice issues, and to address their significance, the scoping process included efforts to contact minority and low-income communities. Public notices were sent to regional Indian Tribes, and to local agencies dealing with area communities.

TABLE 1-2
ENVIRONMENTAL ISSUES RAISED DURING SCOPING AND COORDINATION

Ground Water

- Potential impacts to local water wells associated with mine dewatering and consumption.
- Potential water quality impacts associated with loss of sulfuric acid or leachates to ground water and possible migration from the site.
- Potential groundwater contamination from acid generation and heavy metals following long-term weathering of leach pads and waste rock disposal areas with possible deterioration of liner systems.
- Potential cumulative water quality impacts in combination with other ongoing and historic mining activities.

Surface Water

- Potential downstream water quality impacts associated with weathering and erosion of leach pad and waste dump materials with resultant contamination of runoff.
- Projected water quality of pit waters following mine closure.
- Changes to surface water flow associated with mine dewatering and consumption.
- Impacts to downstream water quality through sediments, toxicity, or salinity of discharges or stormwater runoff.
- Potential cumulative impacts to the watershed from this and other mining activities.

Air Resources

- Potential air quality impacts (dust, acid drift, and odors) to local communities and nearby Class I area. (Superstition Wilderness Area)
- Potential cumulative air quality impacts in combination with other mining activities.

Geology and Minerals

- Efficiency of minerals recovery operations.

  Note: The efficiency of the mineral recovery operation was not analyzed in the EIS. Cyprus Miami is a modern, competitive copper producer and the Interdisciplinary Team believe that the operation is being run in a manner that is not wasting its copper ore reserves. An in-depth analysis of the efficiency of the operations is considered to be outside the scope of this document.

- Impacts to potential future development of other mineral resources.
- Creation or aggravation of geologic hazards from project operations; impacts to project facilities from existing geologic hazards.
- Geochemistry: potential to generate or neutralize acid.

TABLE 1-2 (continued)
ENVIRONMENTAL ISSUES RAISED DURING SCOPING AND COORDINATION

Soils and Reclamation

- Adequacy and type of reclamation to be achieved relative to current land uses, including grazing, recreation, and wildlife habitat.
- Timeliness of reclamation stages as the mining and leaching operation progresses.
- Adequacy of reclamation bonding to ensure success.

  Note: Amount of the reclamation bond would be established by the agencies following a Record of Decision on the EIS. Therefore, evaluation of bond adequacy is not considered an issue for the EIS.

- Susceptibility of the leach pad materials to weathering and erosion.
- Adequacy of the reclamation plan to address site-specific differences in topography, native vegetation, soils, hydrology, and wildlife usage.

  Note: The adequacy of the reclamation plan to address site-specific differences was not analyzed in this EIS. The Interdisciplinary Team determined that any site-specific differences among the pre-disturbance sites would be obliterated by the construction of the facilities and at the time of reclamation, all four sites would have similar conditions on which to conduct reclamation. The reclamation plan does address differences in soil types and seed mixes.

Vegetation/Wetlands

- Potential impacts to protected plant species.
- Potential wetlands impacts associated with direct disturbance and mine dewatering.

Wildlife

- Potential habitat and watering source impacts associated with mine dewatering and consumption.
- Potential waterfowl toxicity associated with leachate solution in ponds and ditches.
- Projected losses of both upland and riparian wildlife habitat.
- Potential enhancement of wildlife habitat through creation of fresh water impoundments and additional wetlands.
- Potential cumulative impacts to biological resources in combination with other mining and development activities in the area.

TABLE 1-2 (continued)
ENVIRONMENTAL ISSUES RAISED DURING SCOPING AND COORDINATION

Special Status Species

- Potential direct, indirect, and cumulative impacts to special status species (e.g., Arizona hedgehog cactus, Arizona agave, and Lesser long-nosed bat).

Cultural Resources

- Direct impacts to known prehistoric and historic cultural sites due to project disturbance.
- Indirect impacts to known prehistoric and historic cultural resources due to increased access and use in and adjacent to the project site.

Socioeconomics

- Preservation of local jobs, support of local economy, and support of tax base to maintain local services and infrastructure.
- Importance of this project to overall copper industry.
- Contribution of this project toward the efficient management of the finite copper reserves in this country.
- Preservation of the local mining heritage.
- Role of mining jobs in maintaining and building the local economy.
- Economic effect of this project on the Phoenix area, Gila County, and the State of Arizona.

Land Use

- Potential impacts to grazing, recreation and other existing uses of public lands in exchange for long-term mining use.
- Potential for long-term public liabilities associated with maintenance of reclaimed leach pads and dumps on public lands following reclamation and bond release.
- Benefits of mining versus other potential uses of the public lands involved.

TABLE 1-2 (continued)
ENVIRONMENTAL ISSUES RAISED DURING SCOPING AND COORDINATION

Recreation

- Temporary or permanent loss of dispersed recreational opportunities in the project area.
- Potential impacts to the Superstition Wilderness, the Salt River Canyon Wilderness, and the Sierra Ancha Wilderness in areas such as air quality and social experience.

  Note: Given the distances to the wilderness areas, the presence of intervening topography, and the absence of designated streams, the Interdisciplinary Team determined that wilderness and wild and scenic river issues were minor issues in this location and did not require detailed analysis.

Visual Resources

- Potential visual impact of reclaimed leach pads and waste rock storage areas to sensitive viewpoints, including U.S. Highway 60 and Arizona Highway 88.

  Note: Given the magnitude of existing disturbance at and surrounding the Cyprus Miami project area, the Interdisciplinary Team determined that visual intrusion was a minor issue in this location and did not require detailed analysis.

Noise

- Potential increased noise impacts to local residents, especially along Bloody Tanks Wash.

Transportation

- Impacts on existing roads and trails within the project area.

Hazardous Materials

- Impacts to the environment due to the accidental release of any hazardous materials and waste regulated under Resource Conservation and Recovery Act (RCRA) and other statutes.

2.0 ALTERNATIVES INCLUDING THE PROPOSED ACTION

This chapter describes the proposed expansion of copper ore leaching facilities at the Cyprus Miami mining operations, reasonable alternatives (including the No Action alternative) and other potential alternatives that were considered but eliminated from detailed analysis. The chapter also includes a comparative summary of environmental impacts anticipated in relation to the various alternatives.

2.1 EXISTING FACILITIES

Cyprus Miami owns and operates a large open-pit mine and leaching operation in the Globe-Miami mining district. Mining is currently being conducted in three pits to provide ore to six active leach pads. There are seven active waste rock disposal sites. The Cyprus Miami complex also includes solvent extraction and electro-winning (SX/EW plants), and a rod plant. A smelter and electro-refinery are also present on site. The smelter processes copper concentrates from off-site locations into anodes. The anodes are sent to the electro-refinery where they are converted to cathode copper. These facilities operate independent of and are not associated with the mining and leaching operations and are not, therefore discussed in this EIS. Additional facilities include offices, shops, tank farms, utility corridors, water management facilities, dewatering wells, water supply wells, access roads, and haul roads.

Lands where Cyprus Miami conducts operations comprise both patented and unpatented mining claims. Approximately 5,640 acres have been disturbed over the past 100 years. Approximately 950 people are employed at the Cyprus Miami facility.

2.2 ALTERNATIVE DEVELOPMENT PROCESS

The Proposed Action was developed by Cyprus Miami after a detailed site selection study (Whitman & Company, 1995a). Alternatives to the Proposed Action that are analyzed in this EIS were developed by the BLM/Forest Service interdisciplinary team using information from a number of sources: scoping comments from the public, a review of the Cyprus Miami Operating Plan, studies conducted by Cyprus Miami for purposes of developing the Operating Plan, and BLM/Forest Service personnel. Four categories of alternatives were considered: 1) changes in the location of facilities; 2) changes in leaching cycles; 3) changes in the capacity of leach pads; and 4) changes to the order of construction and operation of the leach pads. Each alternative was evaluated in a screening process according to the five criteria listed below:

- Does the alternative meet the purpose of and need for the project as described in Section 1.2?
- Is the alternative technically and operationally feasible (i.e. can it be built and operated)?
- Are there any pre-existing environmental constraints to the alternative?
- Is the alternative economically feasible?
- Can the alternative be legally permitted at the current time without regulatory constraints?

These five criteria were used to conduct a "fatal flaw" analysis of alternatives. There were only two alternatives (Proposed Action and Alternative A) that remained for consideration as a result of this analysis. This analysis is described in detail in Sections 2.4 and 2.5 of this chapter and are analyzed for environmental consequences in subsequent chapters. In addition, the No Action Alternative is analyzed as required by law. Alternatives that did not satisfy all of the above criteria are briefly discussed in Section 2.7 of this chapter, but are not analyzed in subsequent chapters.

2.3 NO ACTION ALTERNATIVE

There are two definitions of "no action" provided in NEPA. The first definition occurs when a new project is proposed at an undisturbed site. In this case, no action means the project is not approved and no site disturbance occurs. The second definition occurs when there is an existing operation in place, such as an expansion of an existing project as proposed for the Cyprus Miami project. In this case, "no action" means the expansion is not approved, but the existing operation essentially can continue to function in accordance with existing permits and regulations.

Under this alternative, Cyprus Miami would continue mining and placing ore on existing facilities until all remaining capacity in existing facilities was filled. Total existing disturbance is approximately 5,640 acres. No ground disturbance of public lands would occur outside existing permitted operations (**Figure 2-1**). **Figure 2-1** also shows where existing disturbance occurs on BLM, Forest Service and private lands and identifies existing facilities. Existing permitted operations include mining, leaching, and copper recovery as described in Mining Plan of Operations MPO 81-P-003 approved by the BLM and in the Plan of Operations No. 89-12-02-003 (as amended) approved by the Tonto National Forest dated 1988. No new infrastructure would be approved. Cyprus Miami would disturb minor amounts of their land to fully utilize their available space.

Remaining capacity on existing leach pads would allow ore placement to peak at 29 million tons per year in 1997, then decline steadily until all capacity is reached in 2007 (**Figure 2-2**). At that time, mining and ore placement would cease. The No Action Alternative has an average production rate of 17 million tons per year, slightly more than half the production rate of the Proposed Action (average of 29 million tons per year through 2011). Leaching of residual copper would continue for 10 years or more beyond the final ore placement.

Some specific activities would include the following (see **Figure 2-1**) (Note that "dumps" as used here refers to both waste rock disposal sites as well as active leach pads):

- 9 Dump would continue receiving ore for leaching as a combined South Dump System through 2004.
- 22 Dump would continue receiving waste rock.
- 26 Dump would continue receiving waste rock.

Cyprus Miami Mining Corporation
Leach Facility Expansion EIS

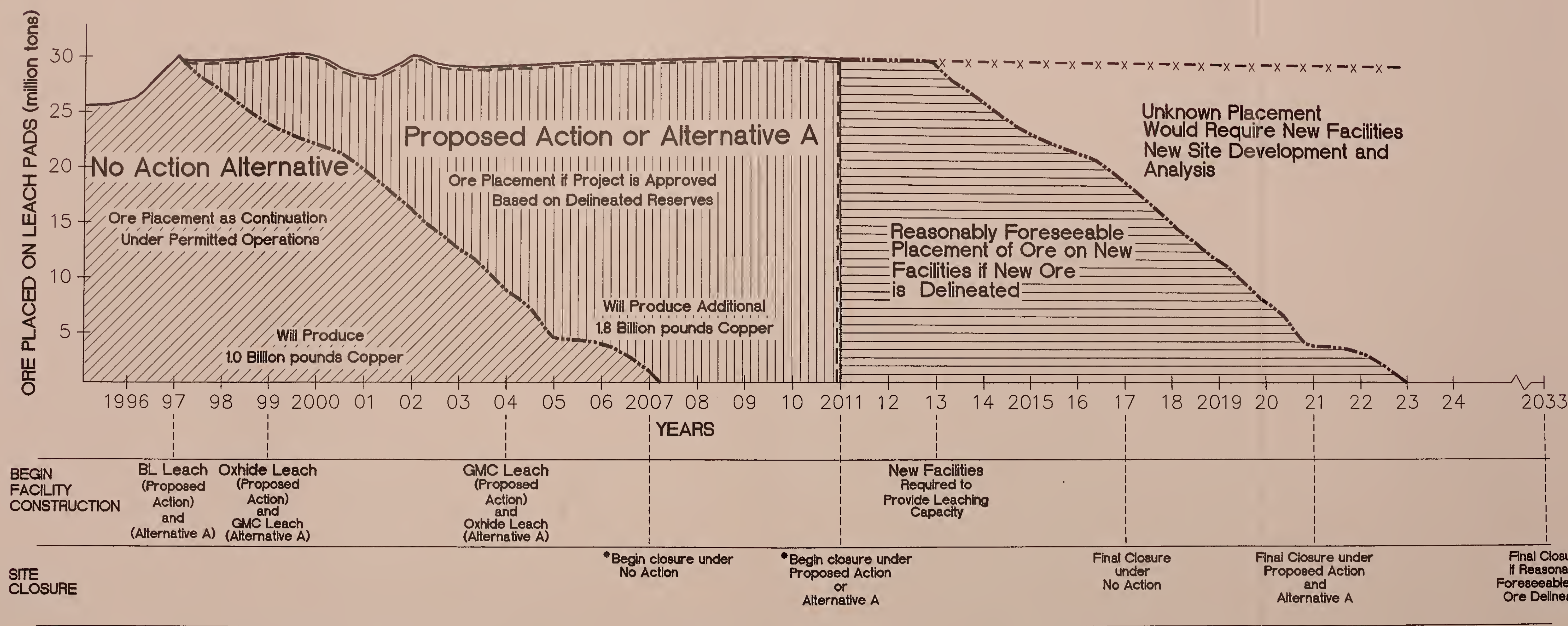
Figure 2-1

NO ACTION

GREYSTONE

Source: Golder Associates, Inc.

Rev. 2/27/97



*Note: After are placement ceases, There would be a period of residual copper recovery through recirculation of leaching solution until no longer economical. Final site closure would ocuur after residual copper recovery (approximately 10 years). Also see Table 2–3

Rev 2/26/97

Source: Cyprus Miami Mining Corporation

Cyprus Miami Mining Corporation
Leach Facility Expansion EIS

Figure 2-2
COMPARISON OF ALTERNATIVES FOR
- ORE PLACEMENT
- CONSTRUCTION OF FACILITIES
- MINE CLOSURE

GREYSTONE

- 27/28 Dump would continue receiving ore for leaching as a North Dump System through 2007.
- 30 Dump would continue receiving waste rock.
- 31 Dump would continue receiving waste rock.
- 34 Dump would continue receiving ore for leaching as a combined South Dump System through 2004.
- 35 Dump would continue receiving ore for leaching as a combined South Dump System through 2004.
- 37 Dump would continue receiving waste rock.
- 38 Dump would continue receiving waste rock.
- 40 Dump would continue receiving ore for leaching through 1998.
- 94 Dump would continue receiving waste rock.

The amount of copper recovered during the approximately 20 years of operations would be approximately one billion pounds. Known ore reserves would be left in place and perhaps not recovered.

Site closure would be accomplished and reclamation on public lands and site closure activities would begin around 2017 in compliance with the existing operating plans approved by the Forest Service and BLM, as cited earlier in this section. Site contouring, road closures, facility removal, growth medium redistribution, and revegetation efforts would require approximately one year to accomplish. Vegetation monitoring would be conducted over the following year.

2.4 PROPOSED ACTION

2.4.1 General Project Description

The Proposed Action consists of constructing three new leach facilities (referred to as the Oxhide facility, the BL facility, and the GMC facility) and one waste rock disposal site (Barney waste rock disposal site) (**Figure 2-3**), together with the required ancillary facilities such as access/haul roads, solution pipelines, and surface water control structures. (Note that this EIS uses the term waste rock disposal sites while Cyprus Miami's Operating Plan uses the term overburden disposal sites. For purposes of this analysis, they are the same.) The leach facilities would be used for placement and subsequent leaching of copper-bearing ore mined from reserves located on lands owned by Cyprus Miami. The Proposed Action components would be constructed on a combination of private lands owned by Cyprus Miami and mining claims on public lands administered by BLM and the Forest Service. Land ownership for individual project components is shown in **Table 2-1**. (Also see Section 3.8.1 and Figure 3-14 Land Ownership.) All legal descriptions shown under the individual facility descriptions are all located within the Gila and Salt River Meridian.

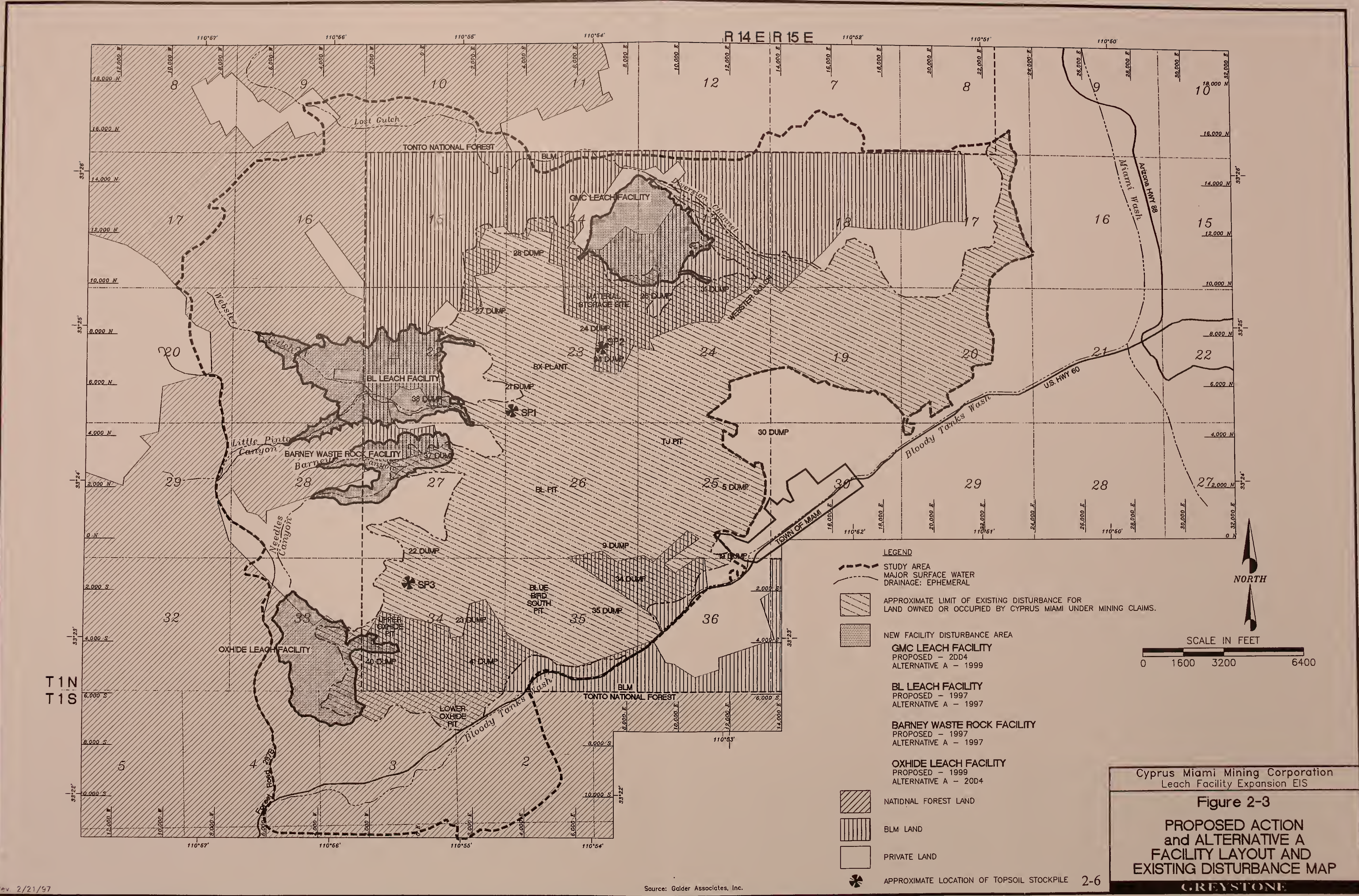


Figure 2-3

PROPOSED ACTION and ALTERNATIVE A FACILITY LAYOUT AND EXISTING DISTURBANCE MAP

Table 2-1. Summary Of Impacted Acreage By Land Ownership For Each Of The Proposed Facilities (under Proposed Action and Alternative A)

Owner Status	Existing Disturbance Within Facility Area (acres)[1]	Total New Disturbance Under Proposed Action (acres)	Total Facility Disturbance Including Proposed Action (acres)[2]
BL Facility			
CMMC[3]	13	95	108
BLM	0	165	165
USFS	0	119	119
(USFS Two Impoundments)	0	85	85
Total BL	13	464	477
GMC Facility			
CMMC	0	132	132
BLM	21	143	164
USFS	0	0	0
Total GMC	21	275	296
Oxhide Facility			
CMMC	10	0	10
BLM	4	0	4
USFS	68	199	267
Total Oxhide	82	199	281
Barney Waste rock			
CMMC	38	59	97
BLM	4	42	46
USFS	0	18	18
Total Barney	42	119	161
All Areas			
Total CMMC	61	286	347
Total BLM	29	350	379
Total USFS	68	421	489
Total All Areas	158	1057	1215

[1] Existing disturbance represents acreage within the total disturbance area that has been disturbed by past and current activities.
[2] Facility disturbance areas represent acreage included within the actual leach pad, leach solution collection reservoir or waste rock deposition area limits plus ancillary disturbance, including haul roads, access roads, stormwater diversions, cut slopes, berms, and other associated disturbances.
[3] CMMC acreage at BL facility includes approximately 2 acres for BHP Copper Inc. (formerly Magma) utility corridor realignment disturbance.

Material placed on the lined leach pads would be treated and rinsed with sulfuric acid solutions. The copper-bearing leach solution draining from these leach pads would be collected and treated in the company's existing solvent extraction and electro-winning plants to produce high quality cathode copper. The waste rock disposal site would be constructed to accommodate uneconomic or non-mineralized material removed from the active mining operation. Ore and waste rock would be hauled from existing pits. Haul roads and service roads would be regularly watered and/or treated with a dust suppressant to minimize dust generation. All operations would be conducted throughout the calendar year and no seasonal or other temporary shut-downs are anticipated.

To monitor protection of local groundwater resources, monitoring wells have been installed at numerous sites downgradient from the proposed facilities, solution ponds, and leach solution transfer diversion systems. These wells and the leach facilities would be regularly monitored to detect any threat to groundwater quality.

Under present assumptions, the Oxhide, BL, and GMC leach facilities and Barney waste rock disposal site would operate for 14 years. Development of the proposed leach facilities would enable continuous ore placement from the mine at an average annual rate of 29 million tons through 2011, which represents the final year of the current planning schedule.

Cyprus Miami has expanded its ore replacement rate to produce approximately 160 million pounds per year. The use of the new leach facilities would allow continued production at this increased rate from 1997 through 2011. Total copper recovery from commencement of the proposed expansion facilities through closure in approximately 2021 is estimated at 2.8 billion pounds.

Construction and operation of the proposed leach facilities would be scheduled and coordinated to make maximum use of existing staff and equipment, wherever possible. It is anticipated that the necessary materials haulage equipment, such as trucks, dozers, and graders, would be reassigned from current mine activities along with the required operators. Outside contractors may be used, if necessary, for specialized and short-term tasks associated with site preparation and liner installation. No new employees are expected to be hired.

Residual copper recovery would continue for approximately 10 years after mining ceases, and then the work force in the solvent extraction and electro-winning plants would also face reductions as copper recovery ended.

2.4.2 Design Elements Common to All Leach Facilities

The three proposed leach facilities would involve generally similar site preparation, foundation development, and liner construction procedures. These common elements are discussed in Sections 2.4.2.1 through 2.4.2.8. Features and considerations unique to each of the three sites are described in sections 2.4.3 through 2.4.5.

2.4.2.1 Site Preparation and Foundation Development Procedures

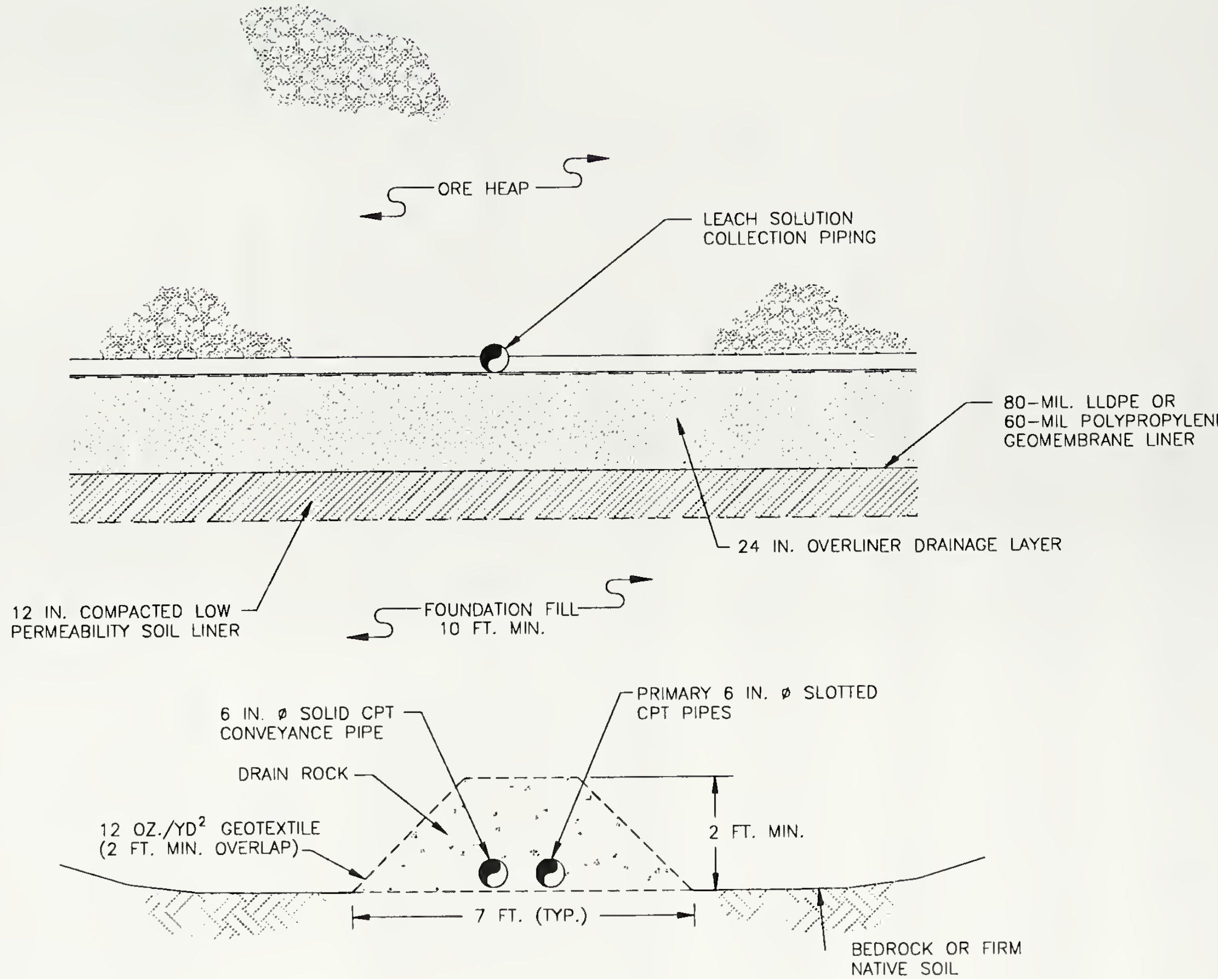
Vegetation would be stripped from the proposed leach pad site as required for geotechnical and construction constraints, where practicable. Suitable soil materials would be salvaged for future reclamation of the site, where feasible and practical. A foundation underdrain system would be constructed to convey any potential subsurface inflows down-gradient of the proposed facilities, thereby eliminating the potential for saturation of the foundation materials (**Figure 2-4**). Primary underdrains would be constructed in all major drainage bottoms and would extend beneath any required upgradient stormwater embankments. Secondary underdrains would be used to convey any potential flows from minor tributaries and from any ancestral underground workings where outflows could potentially occur to the primary underdrains. These underdrains would be constructed of corrugated polyethylene drain pipes encapsulated by durable rock of non-acid-generating nature. The drain pipes would convey seepage flows to foundation underdrain sumps. The underdrain system would also function as a leak collection and recovery system in the event that any leakage occurred. Collected solutions would be regularly sampled and analyzed for major constituents associated with process solutions. Any water collected in the underdrain sumps would be reused in the leaching process or discharged in accordance with applicable regulations.

The leach facility expansion areas would be surface graded to provide a smooth and geotechnically-stable foundation on which to install the liner materials and construct the leach pad. The basic design concept for development of the leach pad foundation is to construct the engineered rockfill foundation with mine waste rock materials, using mine haulage equipment. The specific methods of surface preparation and foundation development would vary based on the surficial geology and topography of each site. In general, two methods of site preparation would be utilized during construction of the proposed leach facility foundations:

1. Cut-and-fill would be utilized in those areas where the surficial materials can be easily cut using dozers. Cut materials would be used for the purpose of filling low areas and small drainages.

2. Fill would be utilized in those areas where resistant units of bedrock are exposed on the surface and cut-and-fill would not be practical. It is anticipated that extensive fill would be required to cover the irregular topography of exposed bedrock surfaces, scattered boulders, and deep arroyos on the proposed sites. In fill areas, the fill material would be compacted to provide a suitable surface for liner and leach pad construction. Total fill thickness would depend on the irregularity of the natural surface.

Certain isolated areas situated in Schultze granite and diorite porphyry, where high vertical-to-near-vertical bedrock faces exist and back filling is not practical, may require bedrock excavation utilizing drilling and blasting techniques. Slopes in such areas would be reduced to provide a suitable surface for liner and pad construction. All slopes would be designed to meet safety factors for mass and seismic stability.



NTS

Cyprus Miami Mining Corporation
Leach Facility Expansion EIS

Figure 2-4

LEACH PAD FOUNDATION AND UNDERDRAIN

GREYSTONE®

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2.4.2.2 Leach Pad Liner Design

Leach pads would be constructed in accordance with the Best Available Demonstrated Control Technology (BADCT) criteria of ADEQ. Each of the proposed leach facilities would be underlain with an engineered rock fill foundation and an impervious geomembrane liner system. The general liner system, as illustrated in **Figure 2-5**, would consist of the following components:

- A minimum 12-inch thick layer of fine grained, low permeability tailings material placed over the rock fill foundation materials to provide a protective bedding and composite soil liner for the geomembrane liner;

- An impervious geomembrane of 80-mil-thick linear low density polyethylene (LLDPE), or 60-mil polypropylene;

- A solution collection piping network to drain the percolating leach solution from the leach pad, thereby preventing development of excess hydraulic pressures on the composite liner; and,

- Placement of at least 2 feet of crushed ore immediately above the geomembrane liner to provide a very porous drainage layer and protect the liner during pad loading operations.

Cyprus Miami's design contractors conducted geotechnical testing and settlement modeling to optimize final pad designs for stability settlement, recovery of process solutions, and closure considerations (Golder Associates, Inc., 1995a). The entire base area for each heap leach pad was modeled for settlement on a 50 ft. by 50 ft. rectangular grid, at approximately 1-foot depth intervals. The results of this work contributed to development of final specifications for the foundation fill design and geomembrane selection.

2.4.2.3 Leach Solution Collection Reservoir Design

Leach solution collection impoundments at the proposed leach pads would be constructed in accordance with the BADCT criteria of ADEQ. The impoundments would utilize an engineered, zoned earth and rockfill dam, which would require a permit from the ADWR under regulations for dam safety. Each impoundment would be sized to accommodate full containment of the 100-year, 24-hour storm event (5.5 inches) plus 8 hours of drain down, as a contingency in the event of a temporary loss of pumping capacity. In addition, each facility has been designed to provide full containment of flows resulting from the wettest month on record. Storage capacities for the individual facilities are discussed in subsequent sections of this chapter.

Design details of a representative leach solution collection reservoir are shown in **Figure 2-6**. The liner system for the operational levels of the impoundments would consist of two impervious geomembrane liners separated by a gravity flow leak collection and recovery system. The lowermost geomembrane liner would be 40-mil-thick HDPE bedded on a low-permeability soil

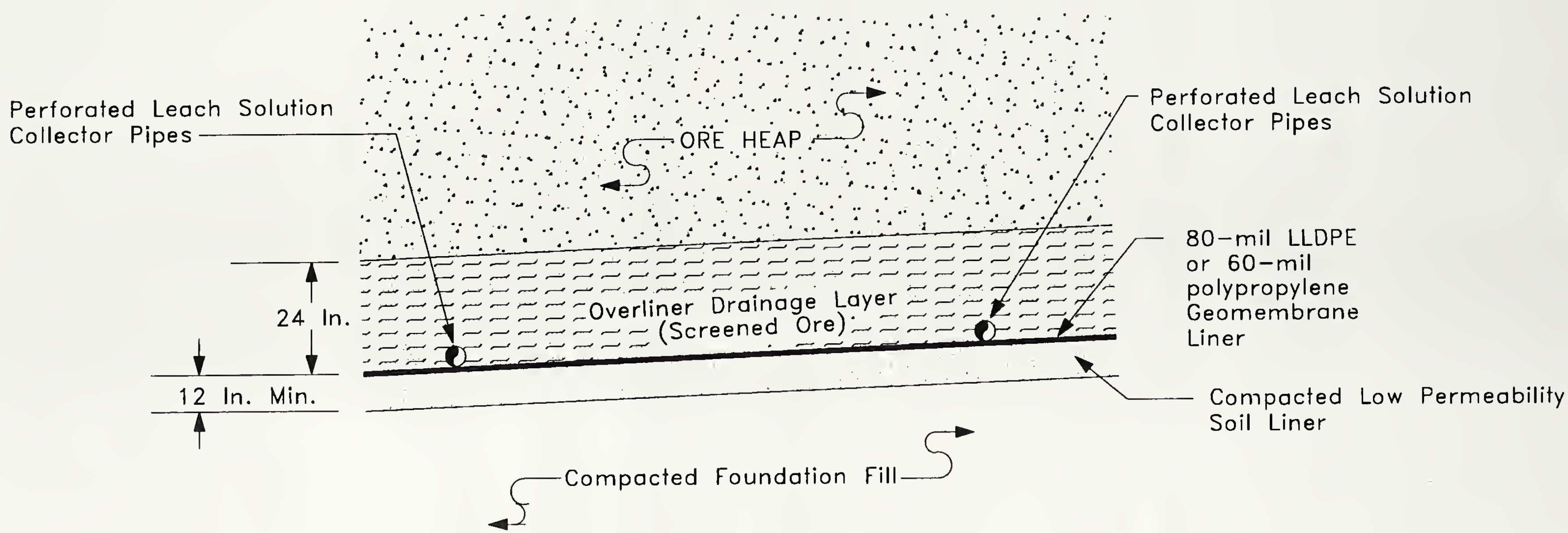

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Figure 2-5

LEACH PAD LINER DESIGN

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layer, similar to that used under the leach pad liner. The upper liner would be 80-mil-thick HDPE. Any leakage collected between the liners would flow to a central sump from which it would be pumped back to the respective leach solution collection reservoir.

For those levels of the impoundments designed to solely contain contingency storage from extremely low frequency upset conditions, the liner system would consist of a single geomembrane liner bedded on a protective fine-grained, low permeability soil material (**Figure 2-6**).

2.4.2.4 General Design Criteria for Leach Facilities

Development of the proposed leach facilities would generally follow several identical design criteria at each of the proposed facility sites. These criteria include the following:

- Nominal lift heights for ore placement of 15 ft;
- Overall final facility slopes with a ratio of 2.5 horizontal units to 1.0 vertical unit (2.5H:1V);
- Haul road widths of 110 ft;
- Service roads of 50 ft width along solution transfer routes and stormwater diversion channels;
- Stormwater diversion systems constructed to handle the 100-year, 24-hour event (5.5 inches) (specific information on facilities is provided in subsequent sections 2.4.3 through 2.4.4); and
- Stormwater diversion channels of a V-configuration with 1.5H:1V side slopes in cut areas and 3H:1V side slopes in fill areas.
- All slopes (leach heap, road berms, channels, diversions) would incorporate appropriate safety factors for mass and seismic stability.

2.4.2.5 Application of Leach Solution

The proposed leach facilities would be operated as closed circuits, with minimal evaporative losses of process solution. Barren leach solution (solution not containing any dissolved copper) would be pumped from the existing SX/EW plants. The barren leach solution would be sprinkled over the leach pads through a series of emitters (or "wobblers") placed on a surface-lain pipe system at an application rate of 0.0030 to 0.0047 gallons per minute per square foot. The wobblers are designed to distribute the solution in an approximate 50-foot diameter circle with droplet sizes of three to six millimeters. This droplet size and rate of application is designed to minimize misting, wind drift, and evaporative losses. Fresh lifts on the leach facility would be treated initially for up to 10 days with a solution in which the sulfuric acid

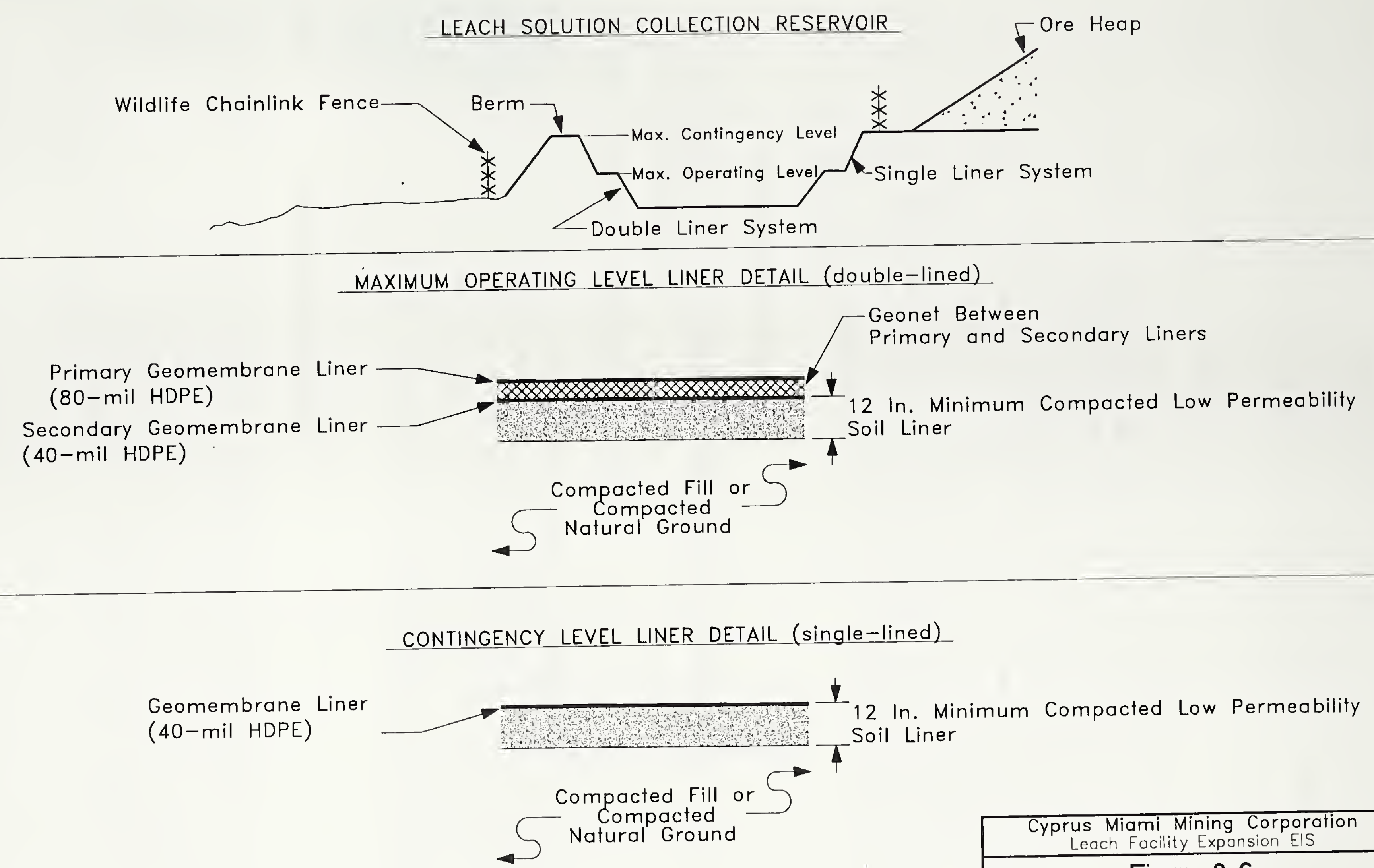

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Figure 2-6

LEACH SOLUTION COLLECTION RESERVOIR AND LINER DETAIL

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concentration is approximately 225 g/l. This would be followed by a nominal leach rinse cycle of 90 days using a barren solution of about 10 g/l sulfuric acid.

2.4.2.6 Mitigation of Historic Workings

The proposed facilities areas have been surveyed to identify and characterize old mine workings that could potentially collapse under a leach pad (Golder and Associates, Inc. 1995b). Minor features, such as surface diggings, test pits, and small waste piles, would be filled or leveled as part of the surface preparation during pad construction. Where workings exist of sufficient size or depth to warrant mitigation, appropriate steps would be taken to protect the integrity of the pad liner system. These steps may include, depending on the individual situation: gravity backfilling of shafts or dipping adits, ripping and caving of the near surface roof materials, emplacement of engineered rockfills in remaining surface voids, and construction of secondary underdrains from these old workings to convey any potential outflows to the primary leach pad underdrain system. Cyprus Miami has developed specific mitigation plans for each of the historic workings, using these general procedures, or more elaborate procedures where necessary to protect the lining system.

2.4.2.7 Solid Waste Handling

All non-recyclable waste, garbage, or refuse would be hauled off-site and disposed in a permitted sanitary landfill.

2.4.2.8 Hazardous Materials Handling

At 10 existing acid storage sites, sulfuric acid is stored for mixing, dilution, and transferring to the leach pads. A secondary containment system is employed to capture any spillage or leakage from the storage tanks which are closed surface structures. Spills from pipelines are detected by an alarm system at the plant. Spills would be handled in accordance with the Spill Prevention, Countermeasures and Control Plan (SPCC) (Cyprus Miami Mining Corporation 1993) and with applicable laws and regulations. Additional information on hazardous materials is presented in Section 3.12.

2.4.3 Oxhide Leach Facility

The Oxhide leach facility would be constructed and operated mostly on federal lands administered by the Forest Service. Federal lands that would be utilized in the construction and operation of the Oxhide leach facility include portions of the N½ of Section 3 and the NE¼ of Section 4, T.1S., R.14E., and portions of Sections 33, T.1N., R.14E. These areas are in the Needle Creek drainage, an ephemeral wash, and the adjacent unnamed ephemeral drainage to the west. Needle Creek has been intercepted by mine features but the unnamed wash is tributary to Bloody Tanks Wash (**Figure 2-7**).

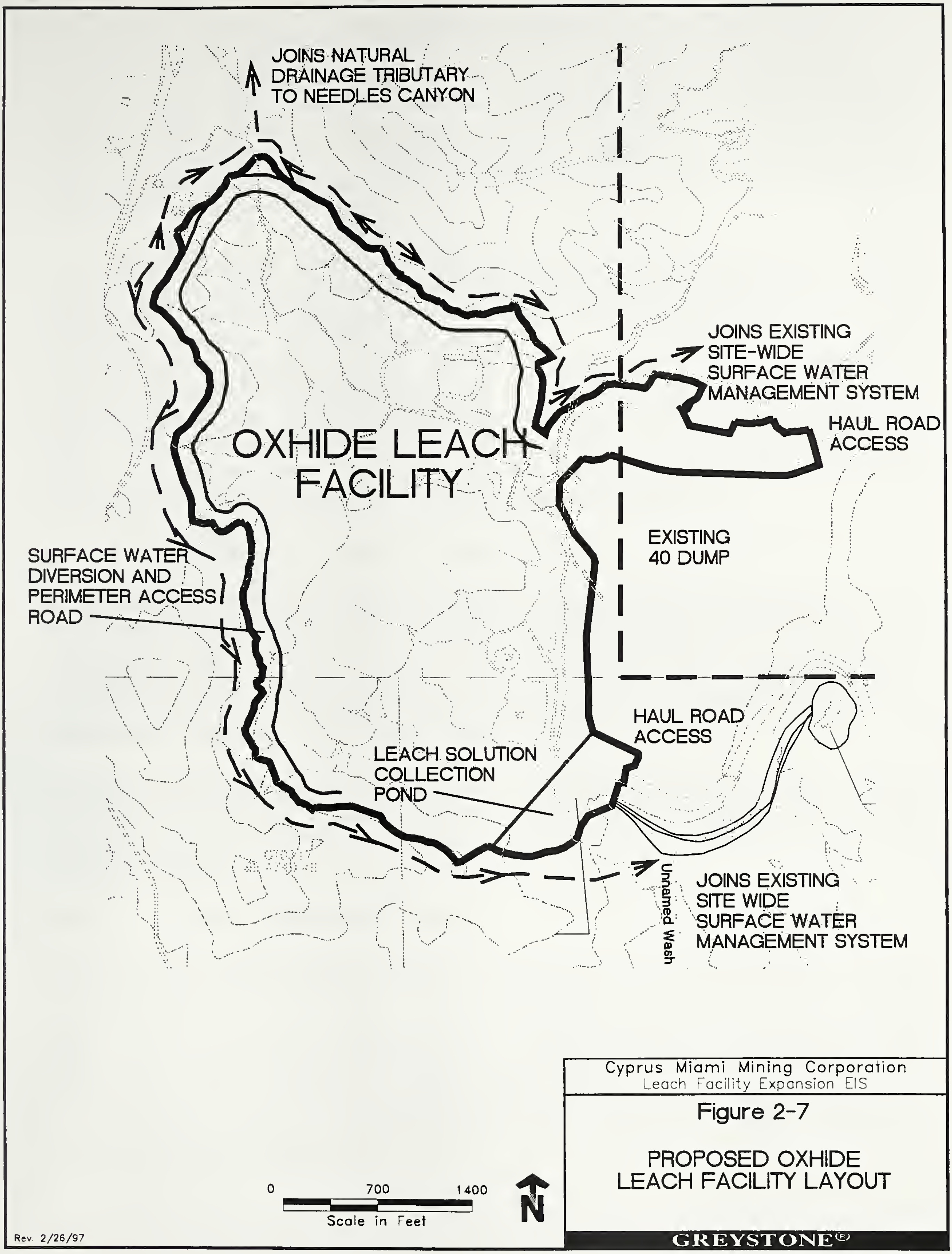

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Figure 2-7

PROPOSED OXHIDE
LEACH FACILITY LAYOUT

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The Oxhide leach facility would consist of the leach pad of approximately 102 million tons capacity, a leach solution collection reservoir, a stormwater diversion system, underdrain collection sumps, service and haulage roads, and ancillary facilities. A solution collection reservoir designed to meet Arizona's BADCT standards, would be constructed at the southeast edge of the facility adjacent to the existing 40 Dump, which is currently being leached. The impoundment would be 43 feet high.

The Oxhide leach facility would be situated upgradient to the west and north of the existing Lower Oxhide Pit mining operation and would be constructed adjacent to the existing 40 Dump leach facility. The proposed new Oxhide leach facility would be constructed to a maximum operational elevation of 4,810 feet above mean sea level (ft. above msl). The toe of the embankment for the solution collection reservoir would be at an elevation of approximately 4,400 feet above msl and the embankment would be approximately 43 feet high. The proposed heap leach pad and leach solution collection reservoir would cover an area of approximately 225 acres. Associated disturbance would involve approximately 56 acres for a total of 281 acres (**Table 2-1**). Approximately 82 acres of the area needed for these facilities are already disturbed, so the total new disturbance required is 199 acres (**Table 2-1**).

2.4.3.1 Oxhide Leach Solution Management

Copper-bearing leach solution would be collected on the impervious liner system and conveyed by gravity to the leach solution collection reservoir at the down-gradient limit of the heap. From this reservoir, solution would be conveyed via an HDPE pipeline either to the SX plant for processing or to the existing 1A Leach Solution Impoundment east of the 40 Dump for temporary storage. The existing 1A Reservoir is a triple-lined impoundment designed and constructed in compliance with Arizona's BADCT standards.

The leach solution collection reservoir total containment capacity, including contingency storage, has been calculated as 54.7 million gallons. Containment for the Oxhide leach solution collection reservoir would include approximately 7 million gallons of additional capacity in the existing 1A Reservoir.

2.4.3.2 Oxhide Stormwater Controls

The upstream watershed along the northeastern margin of the Oxhide leach pad is small. Runoff from this watershed would be diverted around the facility to the east into the Upper Oxhide minepit. The western surface water diversion would collect off-site flow from the catchment located west of the proposed heap leach facility. This diversion would discharge unimpacted stormwater into the existing site-wide surface water management system at the southeast corner of the facility. A small catchment at the north end of the facility would discharge unimpacted stormwater into a tributary of Needle Canyon. There would be no offsite discharge of stormwater from the Oxhide facility.

2.4.3.3 Oxhide Leach Pad Access

Continued use would be made of the existing haul and service roads accessing the existing Oxhide leach facilities. A new haul road would be constructed across the existing 40 dump to access the east-northeast margin of the leach pad for the purpose of material placement.

2.4.4 BL Leach Facility

The BL leach facility would occupy about 477 acres and would be constructed in Sections 21, 22, 27, and 28, T.1N., R.14E. in the Webster Gulch drainage and Little Pinto Canyon drainage. The site includes approximately 119 acres of Forest Service-administered lands, primarily in Section 21, T.1N., R.41E., with a very small area in Section 28, T.1N., R.41E. and approximately 165 acres of BLM-administered lands in Section 22, T.1N., R.41E. The remainder of the proposed BL site would occupy private lands owned by Cyprus Miami. Included in that total are 85 acres that represent the maximum possible area of two surface water impoundments that would be constructed on Forest Service lands just upstream of the facility. Only minor disturbance (13 acres) already occurs in the area. The total new disturbance for the BL facility would be approximately 464 acres (**Table 2-1** and **Figure 2-8**).

The BL leach facility would consist of a leach pad with a 224 million ton capacity, a solution collection reservoir, a surface water storage and diversion system, haul roads, and ancillary facilities. These facilities are designed to meet Arizona's BADCT standards. The BL leach pad would be sited west and upgradient of the existing BL pit mining operation in upper Webster Gulch and the tributary drainage of Little Pinto Canyon entering Webster Gulch from the southwest. The leach pad would reach a maximum elevation of 4,720 ft. above msl while the toe of the fill slope in Webster Gulch at the solution collection reservoir would be at an elevation of approximately 4,100 feet above msl.

2.4.4.1 BL Leach Solution Management

The site of the existing Bohme Ranch Reservoir would be used for development of a solution collection reservoir below the toe of the leach pad structure. The current storage capacity of the collection reservoir, including contingency storage, is 65.4 million gallons. The maximum operating storage volume would be 15 million gallons. The embankment for the reservoir would be 52 feet high.

2.4.4.2 BL Facility Stormwater Controls

The watershed upstream of the proposed BL leach facilities site consists of approximately 588 acres of the Upper Webster Gulch drainage, approximately 415 acres of the Upper Little Pinto Canyon drainage, an adjoining slope area of approximately 231 acres north of the leach facility, and a slope area of approximately 30 acres southwest of the leach facility between Webster Gulch and Little Pinto Canyon. The construction of the leach pad in the lower portion of the

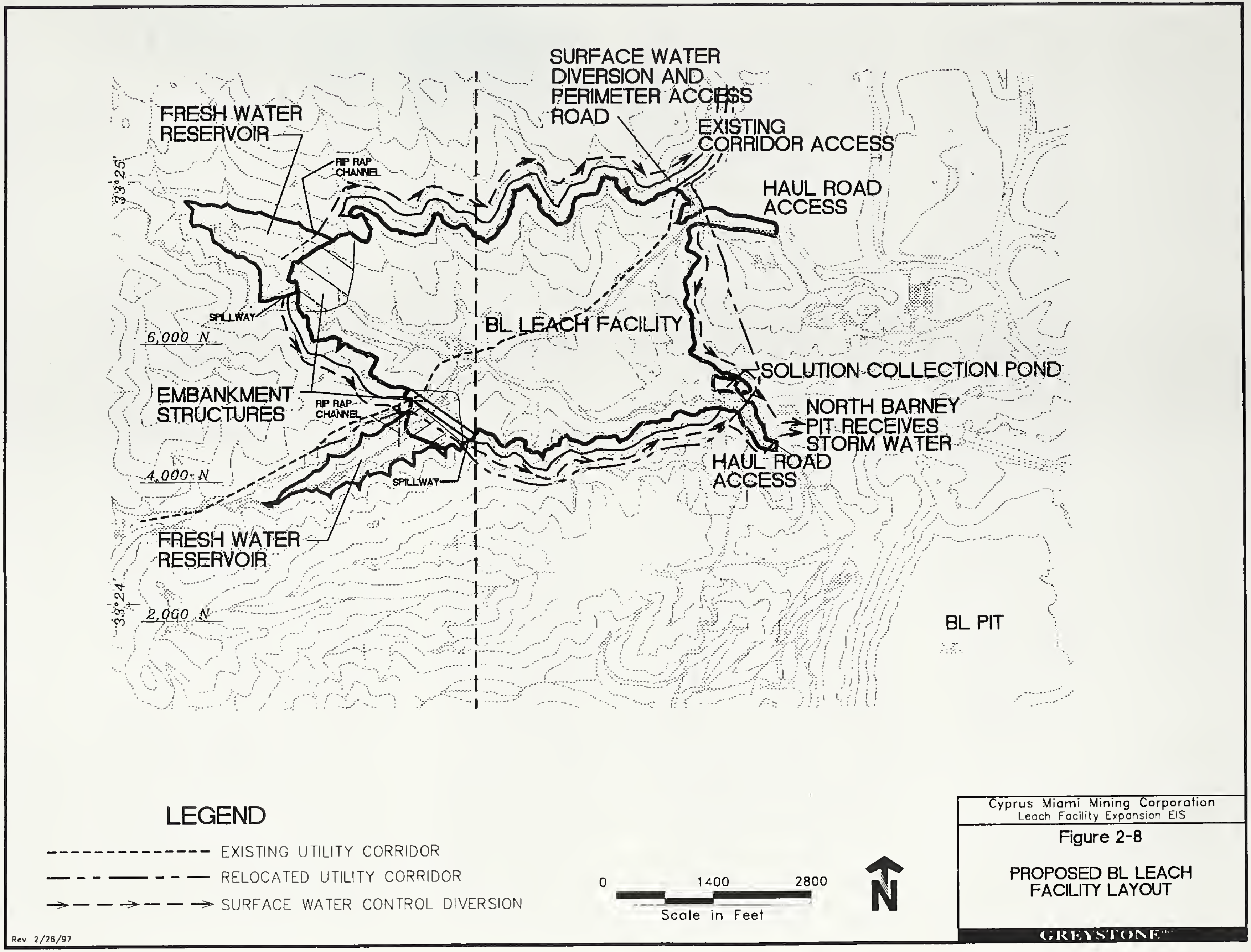

Figure 2-8

PROPOSED BL LEACH FACILITY LAYOUT

Webster Gulch drainage would require control of the upgradient stormwater from these areas. Stormwater from the two primary drainages and the slopes adjoining the leach facility area would be impounded by two retention structures at the western and southwestern edges of the leach pad.

Stormwater upgradient of the BL leach facilities would be diverted around the southern and northern sides of the BL leach facilities through diversion channels that would also function as service roads. Flow from the area north of the leach pad would be diverted to the Webster Gulch surface impoundment. Flow from the area between Webster Gulch and Little Pinto Canyon would be captured in the perimeter diversion channel connecting the two impoundments and directed into the Little Pinto canyon surface impoundment.

The stormwater retention structures (embankments) on the western and southwestern edges of the pad would be constructed in stages as zoned earthen embankments covered by a geomembrane, and with a coarse rock fill armor on the upstream side. Underneath the embankment itself would be located a low permeability barrier blanket, and an underdrain system integral with the heap leach pad underdrain. The remainder of the embankment would be constructed with compacted free-draining engineered rockfill. All waste rock materials used for construction would be non-acid-generating, i.e., Gila Conglomerate. The outboard slopes of the water retention embankments would function as the up-gradient limits of the heap leach pad and would be sealed with the heap leach pad liner system. These slopes would be graded to 2.75H:1V.

The larger of the two embankments would be located in Webster Gulch. The starter dam would be constructed with a crest elevation of 4,310 feet above msl, with the ultimate embankment crest elevation being 4,400 feet above msl. The embankment in Little Pinto Canyon would be constructed in stages, with a first stage starter dam elevation of 4,273 feet above msl and an ultimate crest elevation of 4,370 feet above msl. Spillways from these impoundments are designed to safely discharge the inflow flood generated from one-half the probable maximum precipitation event (PMP) discussed below.

Both the 100-year, 24-hour storm event, as well as the PMP event (72-hour storm) were used to design both impoundments. The 100-year, 24-hour storm represents 5.5 inches of rainfall and the PMP event represents 27.1 inches of rain. A 200-year water balance modeling simulation was used to predict the maximum expected impounded volume of runoff in the reservoirs during the post-closure period. The simulation calculated and tracked various components, including precipitation, evaporation, evapo-transpiration, infiltration, runoff, and change in soil moisture storage to compute the impounded levels on an annual basis. The maximum predicted impounding storage for each impoundment was estimated from the simulation based on a 10 percent probability of exceedance in 200 years (Golder Associates, Inc., 1996c). The 100-year, 24-hour storm plus the 200-year water balance result in the projections for the two impoundments shown on **Table 2-2**.

Table 2-2. BL Facility Hydrologic Specifications for Impoundments

Parameter	Webster Gulch	Little Pinto Canyon
Peak Flow in Drainage (cubic feet/second)	643	1,250
Maximum Impoundment Capacity (acre/feet)	3,875	1,950
Maximum Dam height (ft)	209	195
Projected Mean Impoundment Capacity (acre/feet)	59.2	1.4
Percent of Time with Water Impounded	88	8

The proposed Webster Gulch and Little Pinto Canyon embankments would need approval under ADWR regulations for dam construction. Both embankments likely would be considered low-hazard dams based on ADWR dam construction criteria, including the presence of secondary containment facilities (pits) and the absence of residential structures immediately downstream. Also, the embankments would be considered stable over the long term because they would both be buttressed by the downgradient BL heap leach pad.

2.4.4.3 BL Leach Pad Access

Access to the BL leach pad would initially occur from the southeast, where the haul road ramp would enter the facility near the southern limits of the leach solution collection reservoir. A second haulage route would ultimately access the leach pad from the 27 Leach Dump, via the saddle located at the northeast corner of the facility (approximate elevation 4,400 feet), once the ore stack height reaches the saddle elevation. The 27 Leach Dump route would be benched into the ore heap slope to provide access to the ultimate crest elevation.

2.4.4.4 Utility Corridor Relocation

There are two existing pipelines owned by BHP Copper, Inc. (formerly Magma Copper Co.) and a powerline that traverse Little Pinto Canyon as they connect the Pinto Valley Mine to the west with BHP's facilities north of Claypool. The utility corridor would be relocated and realigned to cross the proposed Little Pinto Canyon embankment from north to south and then be located along the south and east edges of the BL Leach facility. The new alignment would connect with the existing corridor at the northeast corner of the BL Leach facility (**Figure 2-8**).

2.4.5 GMC Leach Facility

The GMC leach facility would be constructed and operated in the Lost Gulch drainage in Sections 13, 14, and 24, T.1N., R.14E. The areas affected by these facilities include Cyprus Miami lands and BLM-administered public lands. Roughly the north half of this site (132 acres in both Sections 13 and 14) is on private land owned by Cyprus Miami. The southern portion of the site in Sections 13, 14, and 24 is public land administered by the BLM (143 acres). The leach pad and associated facilities would disturb approximately 296 acres (**Table 2-1**), some of which is already disturbed. The total new disturbance for the facility would be approximately 275 acres.

The proposed GMC leach facility would consist of a leach pad with a 127 million ton capacity, a solution collection reservoir, a solution transfer system, three foundation underdrain sumps, and a stormwater diversion system. All facilities would meet Arizona's BADCT standards. These facilities would be located in a hilly area southwest of Lost Gulch on the eastern slope of Day Peaks. This area is split into numerous small drainages sloping northeasterly toward Lost Gulch (**Figure 2-9**).

2.4.5.1 GMC Leach Solution Management

The GMC leach pad grading plan provides for gravity drainage of leach solution from the lined facility via three separate drainages, which generally conform to the natural drainage patterns of the site. Collection of leach solutions from these base grades requires the development of a solution transfer channel along the northeastern limit of the facility to convey flows to the leach solution collection reservoir at the southeastern corner of the leach pad. A service road, 30 feet in width, would be constructed parallel to the solution transfer diversion system. The majority of the diversion system would be constructed in fill areas where drainages are backfilled along the toe of the leach pad. The remainder of the diversion generally would be cut into the side slope and follow the contour of the existing topography.

The leach solution collection reservoir would be constructed within the foundation grading fill at the eastern toe of the leach pad on the west side of Lost Gulch. Prior to placement of construction foundation fill materials, geotechnically-unsuitable sediments that have been captured by the historic sediment control structure would be removed. The pond liner system has been designed to meet or exceed the Arizona BADCT guidelines as previously discussed. The GMC leach solution collection reservoir capacity, including contingency storage, has been designed at 45.2 million gallons.

2.4.5.2 GMC Stormwater Controls

Flows from the upstream watershed on the northwest and southwest sides of the proposed GMC leach pad would be diverted to prevent stormwater from running onto the leach pad. This would be accomplished by intercepting stormwater in diversion channels, which would also function

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Figure 2-9

PROPOSED GMC LEACH FACILITY LAYOUT

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as service roads, on the upgradient margins of the leach pad. Stormwater flows north of the facility would be redirected into the natural drainage along the northeastern limits of the facility and drain into the Lost Gulch drainage upstream of the existing surface water diversion structure, where surface flows are diverted around the historic Webster Lake along the northern side of Lost Gulch. The southwest stormwater diversion would be located adjacent to the access road for diversion of surface water run-off around the southern perimeter of the site. These flows would be collected in a small catch basin with a piping inlet to transfer the discharge in a pipeline across Lost Gulch, and into the existing diversion ditch on the north side of Lost Gulch. Surface flows discharging from the existing diversion on the north side of Lost Gulch would drain into the site-wide surface water control system.

The southern diversion channel and associated catch basin would be constructed to accommodate the 100-year, 24-hour storm (5.5 inches). The outlet transfer pipe would provide gravity flow across Lost Gulch with a 10-foot decrease in elevation between the inlet and the outlet.

2.4.5.3 GMC Leach Pad Access

Access to the GMC leach pad would be along the southeastern corner of the pad, with ramps developed to higher levels as the ore elevation increases. The ultimate ore heap crest would be accessed by integrating a haul ramp from the west.

Continued use would be made of the existing roads accessing the GMC leach facilities project site. These existing roads would be periodically maintained, repaired, or upgraded for the purposes of meeting Mining Safety and Health Administration (MSHA) safety standards and efficiently conducting operations. New haul roads, 110 feet in width, would be constructed along the southeastern side of the leach pad for the purpose of material placement. As mentioned above, new service roads would also be constructed along the stormwater diversion system and along the solution transfer diversion system.

2.4.6 Barney Waste Rock Disposal Site

The proposed Barney waste rock disposal site would be constructed and operated in the Barney Canyon and Needle Canyon drainages in Sections 27 and 28, T.1N., R.14E. as an expansion of the existing 37 Dump waste rock disposal site. The proposed Barney waste rock disposal site encompasses approximately 161 acres. This includes 97 acres of Cyprus Miami lands in three parcels in Sections 21 and 22, 46 acres of BLM-administered public lands in Section 22, and 18 acres of Forest Service-administered public lands in Section 21. There are approximately 42 acres of existing disturbance in this area, 36 acres of which are the existing 37 Dump. The total new disturbance of the Barney waste rock site would be approximately 119 acres **(Table 2-1)** and **Figure 2-10**.

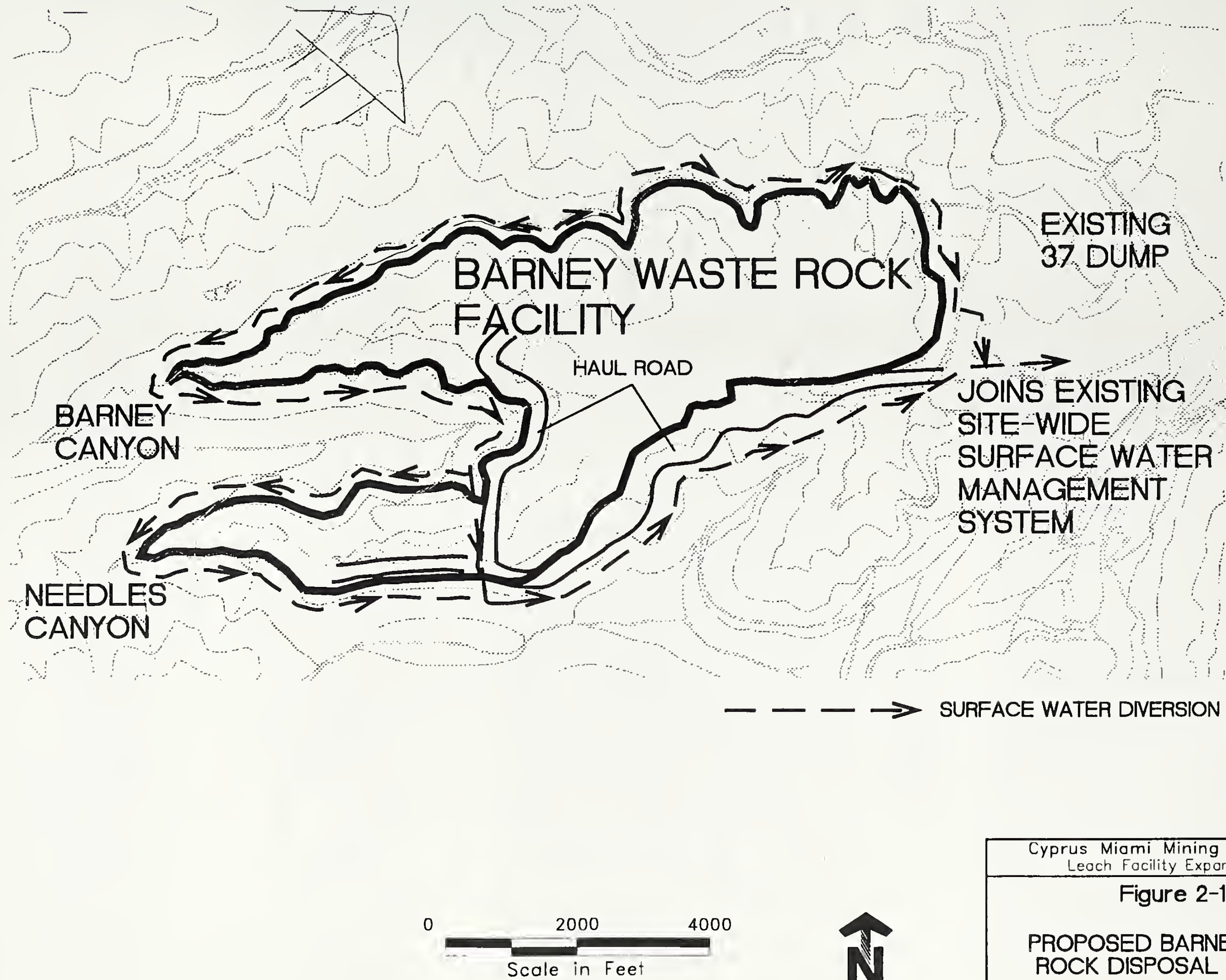

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Figure 2-10

PROPOSED BARNEY WASTE ROCK DISPOSAL FACILITY

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2.4.6.1 Barney Waste Rock Site Design

The Barney waste rock disposal site would be constructed in lifts through end dumping and dozing. The final lift would be constructed to leave a hummock-like surface topography. The facility would have angle-of-repose slopes and a maximum elevation of 4,550 feet above msl, providing a total storage capacity of approximately 74 million tons of waste rock. Waste rock placement at this facility would consist almost entirely of Gila Conglomerate. This would provide a designated stockpile of Gila materials available as a reclamation medium at the various Cyprus Miami facilities. Materials placed in the Barney facility would be determined by implementation of the Waste Rock Handling Plan that Cyprus Miami has prepared for this project (Golder Associates Inc. 1996d).

2.4.6.2 Barney Waste Rock Disposal Site Stormwater Controls

At closure, runoff from the facility would be diverted around the facility via surface water diversions located along the alignment of the proposed haul road system. Stormwater from the up-gradient Needles Canyon and Barney Canyon watersheds would be diverted around the margins of the proposed facility to the existing surface water impoundment located down-gradient of the facility. The areas of the up-gradient drainages are approximately 290 acres for the Needles Canyon drainage, and approximately 105 acres for the Barney Canyon drainage. The perimeter diversion channels would collect surface flows and direct the runoff from the two watersheds to a central collection point located along the southern perimeter of the facility. From there, the flow would be diverted to the east along the proposed and existing haul roads. A smaller catchment of approximately 9 acres within the Barney Canyon drainage, located at the northeastern corner of the facility, would be diverted to the southeastern corner of the facility where it would be combined with flows from the southern diversion prior to entering the existing surface water impoundment.

All storm flows would be routed in channels around the facility. The design storm for the diversion channels is the 100-year, 24-hour event (5.5 inches). Channel reaches constructed in bedrock would be V-shaped in cross section with 1.5H:1V maximum side slopes. Channel reaches constructed in fill would be V-shaped with 3H:1V side slopes. The peak flow anticipated for these channels is 90 cubic feet per second. The channels are sized to accommodate even larger flows.

2.4.6.3 Barney Waste Rock Disposal Site Access

The proposed facility would be accessed at the eastern end of the facility by the existing 37 Dump haul road and a system of new haul roads constructed within the waste rock fill area.

2.4.7 Reclamation and Closure Plan

Cyprus Miami has proposed a conceptual reclamation plan for stabilization of the disturbed areas. Reclamation would be in accordance with applicable federal and state regulations at the time of closure. The goal of the reclamation plan would be to reestablish conditions that are compatible with the post-mining land uses proposed for the site. These uses include mineral extraction and processing, wildlife habitat, grazing, and dispersed recreation. Ongoing and phased reclamation measures are described in Cyprus Miami's plan.

Reclamation on public lands would be covered by a reclamation bond during the life of the proposed operations. Cyprus Miami has estimated the cost of their reclamation plan and after review by the Forest Service and BLM, a final bond amount would be determined. Cyprus Miami would then be responsible for submitting the bond to the agencies, and if reclamation was not completed, the bond would be forfeited to cover the costs of reclamation.

2.4.7.1 General Reclamation Approach

2.4.7.1.1 Soil/Growth Medium Salvage

Due to generally limited quantities of soil on slopes and ridges and intermixed cobbles and boulders, Cyprus Miami proposes to salvage soil on an opportunistic basis and to use suitable waste rock materials as a substitute growth medium. Cyprus Miami plans to focus on ensuring that sufficient quantities of segregated capping materials (Gila conglomerate) would be available for reclamation. Cultural treatments such as ripping, tilling, harrowing, seedbed preparation, erosion control, and fertilization would be applied as necessary to achieve revegetation.

Areas where soil may be present would be staked using a standard depth-stake method. Soils that can safely and reasonably be salvaged using available equipment would be removed, and either stockpiled or used on concurrent reclamation activities within the larger Cyprus Miami operations. Stockpiles, if necessary, would be located in one or more of the following areas: (1) in the laydown area of 25/94 dump located on BLM land within the Black Copper Millsites; (2) on patented property east of 38 Dump; or (3) in 'Y's or hairpins in roadways, out of traffic patterns (**Figure 2-3**). Stockpiles would be seeded with fast-growing grass species to guard against erosion and would be monitored periodically and repaired as needed.

In accordance with the Waste Rock Handling Plan (Golder Associates Inc. 1996d), the majority of materials placed in the Barney waste rock disposal site would be Gila conglomerate, which is an acid-consuming material known to be a good growth medium in the absence of adequate soil materials. During reclamation, surficial soil materials and Gila conglomerate materials would be respread on the flat surfaces of the leach facilities such as benches, crests, and reclaimed roads to a minimum depth of one foot. By having salvaged and stored Gila conglomerate materials in the Barney waste rock site, there would be more than adequate volumes to respread over all reclaimed areas. This is expected to increase the potential for

revegetation success. Additionally, by removing these materials from the Barney site for use in reclamation, the ultimate size (and height) of the Barney waste rock disposal site would be reduced at closure.

2.4.7.1.2 Grading and Recontouring

Facilities were designed to minimize grading and contouring at closure. Final grading was designed to create stable land forms that minimize the pooling or ponding of water, and to the extent possible, blend the facility into the surrounding terrain. Crests and benches would remain, but they would be graded to allow conveyance of stormwater run-off, covered with waste rock material, and stabilized by one of the methods described in the revegetation section below.

2.4.7.1.3 Revegetation and Other Potential Soil Stabilization Methods

Cyprus Miami proposes to revegetate level areas, benches, roads, and other portions of disturbed areas utilizing seed mixes developed at their existing operations, as well as new ones developed through test revegetation programs over the 16 to 20 year project life. Cyprus Miami has also proposed an Oak Chaparral/Grass Community revegetation program. The purpose of this program is to provide a revegetated area that resembles pre-existing vegetation in the project area. In addition, test plots would be developed over the life of the project to determine other species that may be incorporated into the proposed seed mixes, which are a mixture of native and non-native species. Final seed mixtures would be developed in the final Reclamation Plan in consultation with the BLM and Forest Service. Revegetation techniques include; hand broadcasting, direct drill seeding and hydro-seeding. Mulching and fertilization would be applied where needed.

Cyprus Miami has developed an internal Holistic Resource Management (HRM) program for their tailings reclamation program that incorporates a seed mix adapted to cattle grazing. Cattle grazing and management on other Cyprus Miami lands in the Miami area have proven effective in minimizing erosion and establishing vegetation on historic tailings. HRM may be attempted on the waste rock disposal site and leach facilities.

Other methods proposed for stabilizing surface areas disturbed include:

- Ameliorative and Adaptive Approach This approach involves the creation of a growth medium that will support vegetation. This can be accomplished by providing increased organic matter, or the addition of material such as limestone, rock phosphate, or phosphogypsum, which can neutralize acidity and raise pH. Typically, these materials are spread over an area and incorporated into the surface (one to two feet) by utilizing a dozer-mounted ripper.

- Rock Veneering This approach involves the placement of a surface veneer (3 to 12 inches thick) of rock material, consisting of cobbles, 3 to 6 inches in diameter. This surface can

be left as is to simulate a desert pavement, or seeded with a shrub mix that could eventually become an oak chaparral ecosystem.

- Combination of Approaches It is anticipated that the final reclamation plan would include some combination of the four methods of stabilization discussed earlier. The specific approach would be determined by the monitoring and evaluation of test plots. The method selected to accomplish the objective of revegetation and stabilization of the site would be based partly on cost and effectiveness.

2.4.7.2 Drainage Control

Diversion systems around facilities are proposed to divert stormwater run-off. The systems include: bench collector channels, haul road channels, and heap leach perimeter channels. Silt collection systems constructed of straw bales, rock, and silt fences, would be used in both permanent and temporary installations. These facilities would be inspected and maintained until revegetation has stabilized the ground surface, then they would be abandoned.

2.4.7.3 Facility Reclamation

Reclamation of facilities would commence once suitable inactive mine areas are available. Much of the site-specific reclamation would be initiated after termination of operations and mine closure, which is currently scheduled during the years 2011 to 2021. The actual date of closure and reclamation would depend on both current and new ore reserves that could be identified. Specific facility reclamation activities are listed below.

2.4.7.3.1 Reclamation for BL, GMC, and Oxhide Leach Facilities

Leaching would continue after the final economic lift is placed on the pads until the solution no longer contains economically-recoverable concentrations of copper. Then the facilities would be allowed to drain down without rinsing. After draining, the process piping on the surface would be removed, but all drainage piping would remain. The surface piping would either be used elsewhere, or buried in the leach facilities. At closure, the sediment in the solution ponds would be tested for metal contamination. If the material is not contaminated, it would be placed on the heaps, prior to grading and revegetation activities. If the material is contaminated, it would be disposed of in accordance with applicable federal and state regulations. This would restore the design capacity of the ponds so that they can be used for sediment/evaporation ponds. The leach facilities would then be graded to facilitate surface drainage, including;

- Backsloping the final few lifts on the crest to minimize flow over the ore heap bench slopes, direct flow to the haul road channels, minimize erosion, and promote safety.

- Grading of any low spots on the crests and benches to provide positive drainage off of the facilities and discourage infiltration.

- Collecting drainage off of the facilities in diversion channels along the roads to direct flow to the perimeter of each facility.

- Installing drainage routes from the lateral limits of the facilities to the leach solution collection reservoirs, lined ponds, or pits, as appropriate.

Following regrading, a cover of growth medium/waste rock material would be placed over the facility crests and benches at a minimum thickness of approximately one foot. A seedbed would be prepared and the cover layer stabilized. Approximately 272 acres are planned for revegetation.

2.4.7.3.2 Reclamation for Barney Waste Rock Disposal Site

It is anticipated that some of the Gila conglomerate placed in the Barney waste rock site would be used as the growth medium for revegetation at the proposed leach pads and other Cyprus Miami facilities. For the Barney site and any other facilities which remain, the final few lifts would be placed to form a hummocky final top surface, which is intended to blend with the undisturbed topography. The hummocky topography would also provide protected micro-niches that can capture moisture and protect young plants from drying winds. These areas also provide cover for vegetation establishment. The top crest would be graded back away from the existing down gradient heaps, towards the haul roads and diversion system. A seedbed would then be prepared and the top crest surface would be stabilized.

2.4.7.3.3 Reclamation on Other Facilities

It is anticipated that the majority of the roads associated with the project would remain after closure. Cyprus Miami would meet with the regulatory agencies to determine which would remain at closure. Any roads identified for removal or closure would be ripped to alleviate surface compaction, graded to blend in with surrounding topography, and revegetated. All roads that serve as stormwater diversions would remain at closure.

All surface facilities and piping that would not be needed for future activities would be dismantled and salvaged for use at other Cyprus Miami facilities or, disposed of with approved methods. Surfaces would be ripped to alleviate compaction and stabilized utilizing methods described previously.

2.4.7.4 Management of Reclaimed Areas

Revegetated areas would be managed by excluding all unnecessary traffic and personnel, implementing practices to manage grazing by domestic animals and wildlife, and undertaking a monitoring program to track success and, if necessary, implement mitigation where needed.

2.5 ALTERNATIVE A - MODIFIED DEVELOPMENT SEQUENCE (AGENCY PREFERRED)

This alternative is identical to the Proposed Action with one important difference: the order of construction of the Oxhide and GMC leach facilities is reversed, as shown below. Dates of construction are approximate.

Proposed Action Alternative		Alternative A—Modified Development Sequence	
BL Leach	1997	BL Leach	1997
Barney Waste Rock	1997	Barney Waste Rock	1997
Oxhide Leach	1999	GMC Leach	1999
GMC Leach	2004	Oxhide Leach	2004

This construction sequence was developed by the joint-agency interdisciplinary team as a proposal which might delay or potentially avoid disturbance to the resources at and adjacent to the Oxhide site. Of the four sites that make up the Proposed Action, the Oxhide site represents the greatest potential risk to natural resources. Resources within the facility site include a pond containing longfin dace and two reaches of willow riparian habitat. Adjacent resources include Bloody Tanks Wash and domestic groundwater wells.

Rationale for developing this alternative is twofold. First, delaying implementation of the Oxhide facility may allow for incorporation of any improved solution control technologies that may be developed in the near future, which could provide improved mitigation of impacts to resources at Oxhide. Second, alternative sites for leaching facilities may be recognized as the corrective action plan (CAP) is developed for the nearby Webster Lake drainage area, located partially on lands owned by Cyprus Miami. The former Webster Lake area and CAP are described below. This could potentially allow for a future modification to the Operating Plan that could eliminate the Oxhide site altogether.

Solution control technology for copper heap leaching is fairly new and has undergone tremendous evolution over the last few years. By delaying construction of the Oxhide facility for seven years, Cyprus Miami would have additional time to obtain knowledge of control technology, not only from the development of their GMC and BL facilities, but also from other large mine projects in the region. If advances are made in the control technology for copper heap leaching, these improvements could be incorporated into the final design for the Oxhide facility. Implementation of future best available technology could more effectively achieve mutual goals of protecting natural resources and efficient recovery of copper laden solutions.

The historic Webster Lake drainage area is within the Pinal Creek drainage. Pinal Creek has been designated by the State of Arizona as a Water Quality Assurance Revolving Fund (WQARF) site. WQARF sites utilize State funds to implement water quality improvement activities. Private entities then reimburse the State's WQARF fund for monies expended. A current source study

is underway in the historic Webster Lake area to characterize the extent of contamination created by historic mining activities and to identify an appropriate CAP. The Arizona Department of Environmental Quality indicates that the investigation and development of the CAP for Pinal Creek would be completed within the next five years, and incorporation of leaching facilities into the former Webster Lake drainage area could be evaluated as an element of the CAP. Delaying development of the Oxhide facility may provide an opportunity to develop a leach facility at the former Webster Lake area, if the CAP allows for such uses at the site. This could potentially result in a modification of Cyprus Miami's Operating Plan at some time in the future that would eliminate Oxhide as a leach site.

2.6 COMPARISON OF ALTERNATIVES

Table 2-3 presents a comparison of various elements of the alternatives, including construction and operation. Detailed discussions of anticipated impacts from implementation of the alternatives are presented in Chapter 4—Environmental Consequences and are summarized in **Table 2-4**.

Table 2-3. Summary Comparison of Facilities and Operations by Alternatives (See Figure 2-2)

Project Element	No Action	Proposed Action	Alternative A (Modified Development Sequence)
Ore Placement	Until 2007 @ 10% reduction per year Total = 263 million tons[2]	Until 2011 or Beyond[1] @ 29 million tons/yr Total = 487 million tons[3]	Same as Proposed Action
New Leach Facilities	No new facilities on public land.	BL 1997[4] Oxhide 1999 GMC 2004	BL 1997[4] GMC 1999 Oxhide 2004
Waste Rock Placement	Until 2007 with a 10% reduction each year. Total = 832 million tons[6]	Until 2011 or beyond[1] @ 62 million tons/yr Total = 906 million tons[5]	Same as Proposed Action
New waste rock disposal sites constructed on public land	None	Barney 1997	Same as Proposed Action
Acres of new disturbance	Public - None Private - 151	Public - 771 Private - 286	Same as Proposed Action
Copper Recovery during Mining	55 million lbs/yr through 2007. 1.0 billion lbs total	160 million lbs/year through 2011. 2.8 billion lbs total	Same as Proposed Action
Copper Recovery - Residual (post-mining)[7]	10 million lbs/yr from 2008 to 2017	10 million lbs/yr from 2012 to 2021	Same as Proposed Action
Site Closure	Leach Facility closure begins 2007. Final leach facility closure: 2017. Residual copper production until 2017.[7] Final reclamation completed 2022.	Leach facility closure begins 2011.[8] Final leach facility closure: 2021 Residual copper production until 2021.[7] Final reclamation completed: 2026	Same as Proposed Action

[1] The information in this table represents no further mining after the expansion under the Proposed Action. However, it is reasonable to assume that Cyprus Miami will identify minable reserves in the area and will continue operations beyond this proposed expansion project.
[2] Denotes total volume of ore that can be placed on existing facilities on Cyprus Miami lands.
[3] Denotes total ore that can be placed on private and public land as a result of approval of the Proposed Action.
[4] Denotes year construction begins.
[5] Denotes total waste rock that can be placed on private and public land as a result of approval of the Proposed Action.
[6] Denotes total waste rock that can be placed on existing facilities on Cyprus Miami lands.
[7] Leach facility closure involves a ten-year period of heap leach solution recirculation which allow for residual copper production up to ten-million tons/year following final placement of ore.
[8] If new ore is delineated all site closure dates for the Proposed Action and Alternative A could be delayed.

Table 2-4. Summary Comparison of Impacts by Alternative

Environmental Resource	Indicator (Units)	No Action Alternative	Proposed Action	Alternative A Modified Development Sequence
Air Resources	Particulate Matter (PM_{10}) (p. 4-13)	3,778 tpy, starting to decrease in 1997.	662 tpy more than No Action	140 tpy less than No Action, source at Oxhide delayed 7 years.
	Sulfur and Nitrogen Oxides (SO_x-NO_x) (p. 4-19)	3,660 tpy, starting to decrease in 1997.	910 tpy SO_2-NO_x more than No Action	166 tpy SO_2-NO_x less than No Action
	Acid Mist (p. 4-20)	Negligible	Negligible	Same as proposed
	Hazardous Air Pollutants (p. 4-19)	3.3 tpy	3.35 tpy	Same as proposed
	Conformity Analysis	Not applicable as already permitted	Full analysis would be needed if selected	Analysis not needed as emissions below threshold
Geology and Minerals	Slope Stabilities (p. 4-25)	Sufficient safety factors	Sufficient safety factors	Same as proposed
	Mineral (Copper) Production (p. 4-25)	55 million lbs/yr 1.0 billion lbs recovered total	160 million lbs/yr 2.8 billion lbs recovered total	Same as proposed
Groundwater	Quantity (p. 4-27)	No change	Depth to groundwater may increase adjacent to the BL pit. No other significant impacts.	Same as proposed
	Quality (p. 4-28)	On site exceedances of AZ standards for SO_2, TDS, Al, Fe, Mn, Cl, Cd, Cr, pH, and radionuclides.	Possible exceedence of aquifer water quality standards (AWQS) for a short distance down-gradient of leach facilities. No other significant impacts.	Same as proposed; no change at Oxhide site for 7 years.
Surface Water	Quantity (p. 4-33)	No change from current conditions.	Current drainage patterns altered. 16 water sources would be covered by the proposed facilities. No other impacts. Surface water contained on-site	Same as proposed, no change at Oxhide site for 7 years.
	Quality (p. 4-35)	No change from current conditions.	Minimal impacts. Surface water contained on-site.	Same as proposed.
	Water rights (p. 4-37)	No change from current conditions.	Amendment or loss of water rights associated with water sources covered by the proposed facilities.	Same as proposed

Environmental Resource	Indicator (Units)	No Action Alternative	Proposed Action	Alternative A Modified Development Sequence
	Waters of the United States (p. 4-37)	No change from current conditions.	Loss of 9.22 acres of open water, drainages, and wetlands.	Same as proposed; a pond, wetland, and drainage at Oxhide not disturbed for 7 years.
	Springs, Seeps and Ponds (4-35)	No change from current conditions.	8 ponds or tanks lost, 7 springs or seeps lost	Same as proposed, 3 ponds and 1 seep at Oxhide not disturbed for 7 years.
Soils and Reclamation	Acres disturbed (p. 4-40)	151	1,057	Same as proposed
	Salvageable topsoil (p. 3-49)	Unknown	512,884 cubic yards	Same as proposed
	Estimate of reclamation success	Revegetation plan is approved. Revegetation and stabilization of various areas.	Revegetation of 272 acres. Various stabilization on about 785 acres.	Same as proposed
	Soil Loss (p. 4-41)	5.4 tons/acre. Total 30,400 tons.	6.9 tons/acre. Total 7,300 tons.	Same as proposed
Vegetation	Acres lost (p. 4-44)	151	1,057	Same as proposed
	Sensitive species affected (p. 4-43, 4-44, 4-45)	No new disturbance	7 acres of Riparian vegetation 0.06 acres of Wetlands	Same as proposed, loss of wetland at Oxhide delayed 7 years. (1.53 ac)
Wildlife	Populations displaced (p.4-47)	No new disturbance	No habitats designated crucial or important	Same as proposed
	BLM or FS Sensitive species affected (P. 4-48)	No new disturbance	From 0 to 14 percent of available habitat affected. No federally-listed T & E species affected. Dace population lost. Some leopard frogs lost.	Same as proposed, Dace population not affected for 7 years.
	Federally-listed T&E species: (p. 4-48)	No new disturbance	None affected.	Same as proposed
Cultural Resources	Sites affected (p. 4-53)	Potential effect to resources on private land.	32, mitigated by treatment plan.	Same as proposed
Socioeconomics	Population (p. 4-58)	0.8 percent decrease.	No change from current.	Same as proposed.
	Changes in Employment (p. 4-59)	425 total positions (309 mine & leach; 116 SX-EW). 10% reduction each year from 1998 to 2007. Workforce in 2007=42.	425 total positions. 10% reduction each year from 2008 to 2011. Workforce in 2011=85.	Same as proposed action.

Environmental Resource	Indicator (Units)	No Action Alternative	Proposed Action	Alternative A Modified Development Sequence
	Environmental Justice (p. 4-59)	Hispanic population disproportionately affected by workforce reduction.	No change from current.	Same as proposed.
	Tax Revenues (p. 4-61, 4-63)	$577.1 million to Gila County.	$1.1 billion to Gila County.	Same as proposed.
	Demand for Public Services (p. 4-63)	Slight reduction.	No change from current.	Same as proposed.
Land Use	Compliance with plans and permits (p. 4-64)	In compliance	In compliance	Same as proposed
	Public road closures (p. 4-67)	No effect	Forest Road 608 closed	Same as proposed
Visual Resources	Comply with VQO (p. 4-70)	In compliance	In compliance	Same as proposed. Oxhide visibility from Hwy. 60 delayed 7 years
	Views from KOP (p. 4-71)	No effect	Not significant	Same as proposed
Hazardous Materials	Spill and Exposure Potential (p. 4-73	No change	Minor increase	Same as proposed

2.6.1 Clean Water Act Section 404(b)(1) Permit Alternatives - Waters of the United States

In accordance with 40 CFR 230, several alternatives to the proposed action were evaluated in order to avoid effects to Waters of the United States. Fourteen sites were evaluated as possible leach pad site locations. These locations are listed and described in **Table 2-5**. In general, the criteria developed by Cyprus Miami for siting the leach pads were: 1) upgradient of existing surface disturbance, 2) away from population centers, 3) environmentally safe and feasible, and 4) operationally and technically feasible. The siting analysis is documented in Evaluation of Leach Pad Siting Alternatives for Cyprus Miami Mining Corporation Leach Facilities Expansion Project (Whitman and Co., 1995a-updated 1996). The proposed sites maximize ore placement per acre of disturbance. In order to meet the spatial requirements for the placement of 30 million tons of ore per year, Cyprus Miami requires three leach pads with adequate surface area. Of the alternatives assessed, there were no sites or feasible combinations of sites that could replace the capacity of the proposed facilities. The exception to this is the former Webster Lake area pad alternatives (see Section 2.7.5). These were eliminated from consideration at this time because of their technical infeasibility due to incompatibility of lake bed sediments and materials with leach pad liner systems.

Table 2-5. CWA 404(b)(1) Permit Alternatives (Waters of the United States)

Area Name	Constructed Capacity (Million Tons)	Federal Acres	Jurisdictional Waters (acres)	Jurisdictional Wetlands (acres)	Habitat Description	Selection Factors
Oxhide	102	199	1.81	0.059 Area created by seepage from manmade impoundment	Located in oak chaparral vegetation community, which is dominated by scrub oak (*Quercus turbinella*). Conspicuous plant associations include beargrass (*Nolina microcarpa*) and pointleaf manzanita (*Arctostaphylos pungens*).	Proposed
Needles 1	28	54	0.0	0.0	Located in the oak chaparral and juniper scrub vegetation communities. The oak chaparral community occurs mainly on the drier south-facing slopes of these areas. It is dominated by scrub oak, with beargrass, point-leaf manzanita, and sotol (*Dasylirion wheelen*) as common plant associates. The juniper scrub community occurs around Needle Mountain and on the dry slopes immediately to the north. It is dominated by turpentine bush (*Ericameria laricifolia*) and snakeweed (*Gutierrezia sarothrae*), with a variety of grasses and scattered Coahuila junipers (*Juniperus coahuilensis*) subdominant.	Too small, too steep
Needles 2	85	137	0.0	0.0	See Needles 1.	Too small, too steep, multiple drainages would mean multiple solution collection facilities
Barney Canyon	36	72	0.32	0.0	Located principally in the juniper scrub vegetation community, which is dominated by turpentine bush and snakeweed. The northern and southern edges of the footprint occur in the oak chaparral vegetation community, dominated by scrub oak and pointleaf manzanita.	Too small
BL	226	379	6.42	0.0	Occurs in the oak chaparral and pinyon/juniper vegetation communities. The oak chaparral is dominated by scrub oak, pointleaf mahogany, and turpentine bush, with a large patch of velvet mesquite (*Prosopis velutina*) located to the east of Bohme ranch. A riparian plant association occurs along Little Pinto Canyon and Webster Gulch. This association is dominated by Fremont Cottonwood (*Populus fremonti*) west of Bohme ranch along Little Pinto Canyon and by Fremont cottonwood and Arizona sycamore (*Platanus wrighti*) east of Bohme ranch along Webster Gulch.	Proposed
Barney Extension	9	66	0.0	0.0	Occurs in oak chaparral vegetation community, dominated by scrub oak and pointleaf manzanita. The southern end of the site is disturbed.	Too small

Area Name	Constructed Capacity (Million Tons)	Federal Acres	Jurisdictional Waters (acres)	Jurisdictional Wetlands (acres)	Habitat Description	Selection Factors
26/94	49	85	0.0	0.0	Located entirely within lands that have been disturbed by mining activity.	Too small, and technically infeasible
GMC	127	275	0.57	0.001	Located mostly in oak chaparral vegetation community. In addition to scrub oak, common plant associates include pointleaf manzanita, mountain-mahogany (*Cercocarpus montanus*), lemonadeberry (*Rhus trilobata*), and Lowell ash (*Fraxinus anomala*).	Proposed
Webster Alone	21	82	0.03 (not counting Lost Gulch)	0.001	See GMC. In addition, paloverde/cactus desert scrub also occurs. It is dominated by blue paloverde (*Cercidium floridum*), white thorn (*Acacia constricta*), fairy duster (*Callandra eriophylla*), and a variety of small cacti.	Too small
Webster After GMC	60	110	.060 (not counting Lost Gulch)	0.001	See GMC. Also, a riparian community occurs along the northern portion of the site. The community is variously dominated by Fremont cottonwood and tamarisk (*Tamarix ramosissima*).	Technically infeasible
Webster GMC Combo	230	220	0.60 (not counting Lost Gulch)	0.001	See Webster After GMC.	Technically infeasible
Myberg 1	15	60	0.0	0.0	Located principally in the oak chaparral vegetation community, which is dominated by scrub oak and pointleaf manzanita.	Too small and too remote, too steep
Myberg 2	70	103	0.0	0.0	See Myberg 1. Also, a small portion of the southeastern end of Myberg 2 footprint is located in oak woodland, which is dominated by Emory oak. Included as common associates in oak woodland are gray oak, alligator juniper and other shrubs.	Too small and too remote, too steep
Lost Day	15	60	0.35	0.26	Located in oak chaparral and pinyon/juniper vegetation community. The southern half of the footprint occurs in oak chaparral, which is dominated by scrub oak and pointleaf manzanita, and the northern half occurs in pinyon/juniper, which is dominated by Coahuila juniper and singleleaf pinyon.	Too small, disturbs wetland

Note: Jurisdictional area for the proposed sites is based on actual field delineation as established by COE. Jurisdictional area for the alternatives is based on estimates from mapping, field verification, and aerial photography.

2.7 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED ANALYSIS

Table 2-6 summarizes the results of the screening process described in Section 2.2, and the following text presents specific rationale why each alternative was eliminated from detailed consideration. Each criterion represents a fatal flaw that prevents that alternative from being viable and eliminates it from being analyzed in detail. A proposed alternative had to meet the purpose and need for the project in order to be considered, and none of the various alternatives offered any site-specific environmental advantages. The areas discussed are shown in **Figure 2-11**.

Table 2-6. Summary of Screening Process for Alternatives (Fatal Flaw Analysis)

Sites	Criteria				
	Meets Purpose and Need	Technical Feasibility	Environmental Constraints	Economic Feasibility	Permitting Constraints
Needles Waste Rock	X	X			
Needles 1	X	X	X	X	
Needles 2	X	X	X	X	
Barney Extension	X	X		X	
Leach Pad on Existing Waste Rock	X	X			X
Historic Webster Lake Sites					X
Myberg 1	X	X		X	
Myberg 2	X	X		X	
Lost Day	X	X		X	
Remote Sites	X			X	
Barney Canyon Waste Rock Disposal Site	X			X	
Three Smaller Leach Pads	X			X	
Two Leach Pads	X			X	

X = Presence of major constraints limiting implementation; a "fatal flaw".

2.7.1 Replace Barney Waste Rock Disposal Site with a Needles Waste Rock Site

This alternative was considered in order to eliminate impacts to drainages and riparian vegetation and because it would be located on private lands owned by Cyprus Miami. The alternative was considered technically infeasible for the following reasons:

- The steep and narrow topography in the Needles area would limit the volume of waste rock that could be placed there.
- Much of the Needles area is already planned to accommodate the westward extension of the 22 Dump. Extension of that dump would be on private land and is not part of this NEPA action.
- The placement of waste rock at the Needles site would make it difficult to remove the subject growth medium for subsequent reclamation purposes.

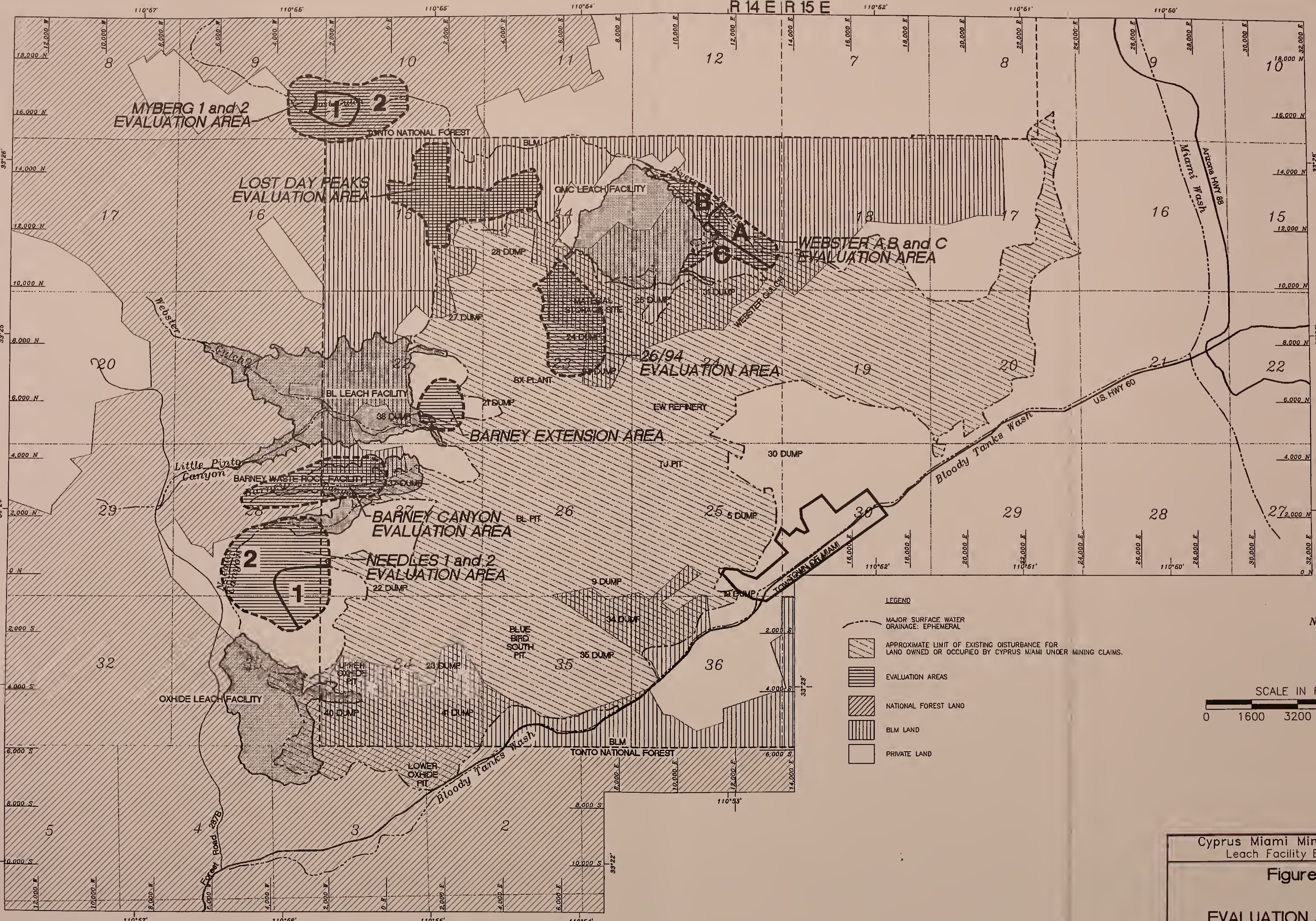
2.7.2 Leach Pad in the Needles 1 and 2 Area

The Needles area is located on the slopes of Needles Peak to the west and up gradient of the BL pit, and west of the existing 22 Dump (**Figure 2-11**). All lands in this area are owned by Cyprus Miami. Two sites in this area (Needles 1 and Needles 2) were evaluated as potential sites for leach pads that could potentially reduce the size of the Oxhide leach pad, but were eliminated from consideration as technically and economically infeasible and environmentally undesirable for the following reasons:

- From 50 to 80 percent of the area is steeper than 2.5:1 and it would not be geotechnically feasible to construct a liner system in such steep topography.
- The available area is smaller than desired and current plans call for waste rock in the 22 Dump to be extended into the Needles area.
- There are three small drainages that would be affected and would require three separate solution impoundments for a relatively small ore capacity. This was considered an environmental constraint.
- The costs of three impoundments and a relatively small capacity rendered development of this area economically infeasible.

2.7.3 Leach Pad in the Barney Extension Area

The Barney Extension site was considered as an alternative leach pad location. The area is located between the existing 27 Dump leaching area and the 38 Dump for waste rock **(Figure**



Cyprus Miami Mining Corporation
Leach Facility Expansion EIS

Figure 2-11

EVALUATION AREAS FOR ALTERNATIVES

GREYSTONE

Source: Whitman & Company/Independent Mining Consultants

2-11). The site was considered because it is close to ore reserves and the solvent extraction plant and is entirely on Cyprus Miami patented land. The site was dropped from consideration as technically and economically infeasible for the following reasons:

- The site is too small to warrant the separate construction of solution collection facilities for a relatively small amount of ore capacity.

- There is an existing water management reservoir in the area which would require relocation.

2.7.4 Leach Pad on Existing Waste Rock Disposal Site

A number of existing waste rock disposal sites were examined as potential leach pad sites. Of these, the 26/94 Dump (**Figure 2-11**) appeared to be the most promising based on size and location. Most waste rock disposal sites are currently being used for waste rock deposition. The 26/94 Dump site is close to the pit exit and is located on patented lands and on previously disturbed public lands. The site was considered because it was already disturbed or actively being used by current operations. This alternative would require the dump to be filled, graded, and have a liner placed on the surface of the waste rock. This alternative was eliminated as technically infeasible for the following reasons:

- The existing waste rock area was not engineered as a subgrade for any future use.

- The waste rock was placed with varying lift heights, which averaged approximately 15 feet, and no compaction was conducted.

- There is high potential for differential settling under the weight of a leach pad and it would be technically difficult to maintain the integrity of a liner.

- The facility is scheduled to receive additional waste rock which would have to be relocated.

- There are also identified mineral resources between 94 Dump and the TJ pit and the best management practices suggest no construction above them.

2.7.5 Leach Pad at Historic Webster Lake Sites

Three designs (Webster A, B, and C) (**Figure 2-11**) were considered that would involve the historic Webster Lake drainage bottom. The designs included both separate pad sites and sites in combination with the proposed GMC facility. However, none of these sites was considered for detailed analysis because the historic Webster Lake area has been designated as a source study area within the Pinal Creek drainage, which has been designated by the State of Arizona as a Water Quality Assurance Revolving Fund (WQARF) site. The time frame for completion of this evaluation and implementation of any corrective actions was not considered compatible with Cyprus Miami's proposed schedule for leach pad development; thus, it was considered

infeasible to plan or evaluate a leach facility in the historic Webster Lake area at this time. In addition, the historic lake bed sediments were not considered compatible with the current designs for a leach pad liner system.

2.7.6 Leach Pad in the Myberg 1 and 2 Area

The Myberg area (**Figure 2-11**) is located more than a mile north of the nearest pit within Cyprus Miami's existing operation. Two designs were considered: one stayed entirely on lands owned by Cyprus Miami, and one included both Cyprus Miami lands and some lands in the National Forest System. The area was dropped from consideration as technically and economically infeasible for the following reasons:

- The distance to the site would mean that haulage costs would be the highest of all sites considered.
- New haul/access roads would have to be constructed, resulting in additional surface disturbance beyond that of the leach pad.
- A new solution collection system would involve an overland pipeline which would pose additional environmental concerns.
- The area contains significant areas with slopes steeper than 2.5:1. There are parcels of private land in the area owned by parties other than Cyprus Miami which could complicate access. Developing the area might be premature as active exploration is being conducted in the area and there is potential for economic mineralization.

2.7.7 Leach Pad in the Lost Day Area

This area is near the Lost Day Peaks north-northwest of the 28 Dump on public lands on which Cyprus Miami has filed mining claims. This site was considered as possibly reducing the size of other leach pads. It was considered technically and economically infeasible for the following reasons:

- The remote location would require construction of access/haul roads and a leachate collection system and increase costs.
- Much of the area has slopes steeper than 2.5:1, resulting in a relatively small pad capacity.
- The construction and operating costs per unit of capacity would be high.

2.7.8 Leach Pad at Remote Sites

This alternative considered the use of one or more leach pads at remote sites, sites which have not yet been identified, but which might present themselves after appropriate study. The alternative was considered to address surface water, groundwater protection, and visual concerns. This alternative was considered economically infeasible for the reasons presented in 2.7.6 above as well as the potential for conflicts with other private landowners.

2.7.9 Construct a Leach Pad on the Barney Waste Rock Site

This alternative would utilize a phased or sequential approach at the Barney site. Initially, waste rock would be deposited at the site as in the current proposal. However, the waste rock would be placed in an engineered fill using underdrains, low lift heights, and compaction operations. After several years of operations, Cyprus Miami would prepare the site with a liner system and start placing ore at the site for leaching. This alternative was considered in order to reduce the size or eliminate other leach pads. This alternative was considered economically infeasible for the following reasons:

- The area is a steep-walled, narrow canyon which results in a relatively small area for leaching even after waste rock has been used to fill the bottom of the canyon.

- The relatively small leach capacity with the high costs of stormwater diversions and a leachate collection system rendered the site uneconomical.

2.7.10 Construct Three Smaller Leach Pads

This alternative was considered to avoid the visual intrusion of large leach pads built to the height of several hundred feet, and to allow a more precise selection of smaller sites and thus provide greater avoidance of significant resources. Cyprus Miami over-designed the leach facilities to provide some excess capacity to give them some flexibility when it came time to address the next planning cycle in 2011. This alternative would have required Cyprus Miami to reduce the area of ground disturbance to the minimum necessary to accommodate the anticipated volume of ore over the mine life, which would minimize disturbance of resources. This alternative was considered economically infeasible for the following reasons:

- The relationship between amount of ground disturbance and surface area for leaching is highly variable. In steep, dissected terrain, the amount of ground disturbance is often large relative to the actual area covered by the leach facility.

- Smaller leach pads have proportionately smaller surface areas for leaching than do large leach pads. This means they reach capacity disproportionately faster than large leach pads. However, smaller leach pads have similar construction costs to larger pads at these sites, so similar costs and decreased capacity rendered this alternative uneconomical.

- Smaller leach pads with reduced capacity might mean capacity would be reached before all identified ore could be placed during the operational period.

2.7.11 Construct Only Two Leach Pads

This alternative was also considered in reaction to the excess capacity in the original design. It appeared that the excess capacity could accommodate much of the material to be placed in a third leach pad. This alternative would require Cyprus Miami to construct only two leach pads somewhat larger than originally planned. Avoiding a third pad would avoid disturbance of many acres of resources. This alternative was considered economically and technically infeasible for the following reasons:

- Two pads were demonstrated by Cyprus Miami to be insufficient for the placement of the planned ore tonnage. The placement of that tonnage (about 29 million tons per year) is needed to produce the pounds of copper that best utilize the existing plants and equipment.

- Two leach pads would likely need to be constructed taller than would three leach pads. However, tall leach pads are less efficient than lower leach pads (there is an optimum height for maximum percolation through the various kinds of leach material). While the two leach pads might disturb less surface area than three pads while still providing sufficient capacity, the design would sacrifice copper recovery.

- Reduced leaching efficiency would require placing new ore on the pad at a faster rate to maintain copper recovery. This would, in effect, shorten the leach cycle and reduce overall total copper recovery.

- Two leach pads would reach capacity faster and ore placement would begin to slow down around the year 2008, and could drop to a level as low as 22 million tons per year by 2011, which is well below the target rate of 29 million tons per year.

3.0 AFFECTED ENVIRONMENT

This chapter describes the existing environment that potentially would be affected by the development of the proposed Cyprus Miami leach facilities expansion (Proposed Action) or project alternatives. Descriptions of the affected environment are provided in the following section by resource. The environmental baseline information summarized in this chapter was obtained from field and laboratory studies of the project area, published sources, unpublished materials, and communication with relevant government agencies and private individuals with knowledge of the site. Resource descriptions are based on the area of potential direct and indirect environmental impacts. This chapter provides a summary of the existing resources of the proposed project area, rather than duplicating available technical information. For more detailed descriptions of a specific resource, please refer to the references provided.

This chapter uses the following terminology:

Study Area	=	This is the area that was studied to gather baseline data for individual resources. For most resources, the study area totals 12,300 acres contained in approximately 31 sections in T.1N., R.14E.; T.1S., R.14E.; and T.1N., R.15E. (**Figure 2-3**). Since the study areas for specific resources may differ, the acreage figures for individual resources are described in those particular sections of this chapter.
Project Area	=	The location of all project-related facilities plus buffer areas regardless of land ownership (public or private); i.e., the total area to be disturbed by the proposed leach facility expansion and related facilities (1,057 acres of new disturbance plus 158 acres existing disturbance = 1,214 acres).
Existing Disturbance Areas	=	The previously-disturbed areas, totalling approximately 5,640 acres, that are part of the Cyprus Miami operations. These include facilities on both private and federal lands and are first illustrated on **Figure 2-3**.
Facility Disturbance Sites	=	The proposed areas of disturbance for specific facilities. The facility disturbance sites range in size from 161 to 477 acres and are first illustrated in **Figure 2-3** and itemized in **Table 2-1**. The total acreage for all facility disturbance sites equals the project area.

3.0.1 Resources Not Likely To Be Affected

The following resources were judged by the joint ID Team to be unaffected by the action alternatives or by the No Action alternative.

Noise - No noise effects on off-site residences are expected for the following reasons:

- Noise-generating operations are not concentrated in any particular area.
- Area topography is a barrier to much of the noise generated on-site.
- Traffic on Highway 60 is louder (63dBA day/58 dBA night) than haul trucks (54 dBA at 2,100 feet at the nearest residence).

Recreation - No effects on recreational opportunities or facilities are expected for the following reasons:

- There is no significant use of public lands for dispersed recreation in the study area (minor hunting, sight-seeing, rock-hounding).
- There are no developed recreation facilities in the vicinity of the project.
- Forest Service roads from the west would be closed for safety purposes.
- The affected public lands have a Roaded Natural Area classification, which allows the sights and sounds of man.

Wilderness - No effects on wilderness areas are expected for the following reasons:

- The three closest wilderness areas are all more than seven miles north and west of the site.
- Topography presents intervening barriers between the site and the wilderness areas.
- There would be no change in noise, lights, or dust generation from existing conditions that would affect wilderness areas.
- The agency preferred alternative, Alternative A, would have a net decrease in fugitive emissions, and would have no effect on visibility or other Air Quality Related Values in the Superstition Wilderness.

This chapter describes impacts to those resources that would be potentially affected by the No Action alternative and two action alternatives.

3.1 AIR RESOURCES

3.1.1 Air Quality

3.1.1.1 Climate and Meteorology

The climate of the project area is influenced by the low latitude, mountainous terrain, and the seasonal influx of moisture from the Pacific Ocean during the winter and the Gulf of Mexico, and occasionally the Gulf of California, during the summer. During the spring and fall, drier air usually dominates the area.

As shown in **Table 3-1**, monthly-average maximum temperatures range from 96.5° Fahrenheit (F) in July to 56.2°F in January. Monthly-average minimum temperatures range from 32.1°F

in January to 70.0°F in July. The monthly-average daily temperature variation ranges from 24 to 30°F throughout the year.

Table 3-1. Climate of Cyprus Miami Project Area

Month	Temperature		Precipitation	
	Average Maximum (°F)	**Average Minimum (°F)**	**Average (inches)**	**Number of Days Precipitation ≥ 0.01 Inches**
January	65.2	32.1	2.17	6
February	60.6	34.9	1.86	6
March	65.2	39.4	1.86	6
April	74.0	46.3	0.73	5
May	83.3	54.7	0.42	2
June	93.7	54.7	0.35	4
July	96.5	70.0	2.51	10
August	93.7	67.7	3.08	6
September	88.3	61.9	1.57	6
October	74.0	50.9	1.25	4
November	65.7	39.4	1.37	4
December	56.6	33.0	2.39	6
Annual Average	76.0	49.5	—	—
Annual Total	—	—	19.55	66

Source: National Oceanic and Atmospheric Administration (NOAA) 1992.

The annual precipitation of 19.55 inches in the project area occurs primarily during summer and winter. During July, August, and September, 36.5 percent of the annual precipitation falls as thunderstorms. In the winter months of December, January and February, 36.6 percent of the annual precipitation occurs during storms moving into the area from the Pacific Ocean. The remaining 32.5 percent of annual precipitation occurs in the other six months of the year. By far, the driest period is April, May, and June. This three-month total, 1.50 inches, is only 7.7 percent of the annual precipitation.

The average number of days when measurable precipitation (0.01 inches or more) occurs varies from 10 days in July, six days in each of the winter months, and two days in the driest month of May (NOAA 1979). Most summer precipitation occurs from short-duration, high-intensity rain events that usually last less than one hour. Conversely, precipitation occurring during winter storms may last for more than 24 hours. In this area, the 100-year, 24-hour storm is calculated at 5.5 inches of rainfall.

Wind velocity was measured at the Cyprus Miami smelter meteorological station (located in the NW¼NW¼SW¼, Section 20, TIN, R15E) from February 1994 to January 1995. The wind velocity sensor is mounted on the top of a 120-foot tower with a base elevation of 3,650 feet above mean sea level (ft-above msl), and a sensor elevation of 3,770 ft-above-msl.

The annual distribution of wind direction and speed is summarized in **Table 3-2a and 3-2b**. The wind is from a southwesterly to westerly direction 57 percent of the time. A secondary maximum direction is from the east-southeast to south-southeast occurring 23 percent of the time. The wind speed exceeds ten knots only 17 percent of the time.

Table 3-2a. Wind Direction

Wind Direction	Frequency (Percent)
North	1.38
North-Northeast	0.18
Northeast	0.79
East-Northeast	0.91
East	1.72
East-Southeast	7.25
Southeast	9.94
South-Southeast	5.40
South	4.32
South-Southwest	5.22
Southwest	13.17
West-Southwest	24.99
West	13.47
West-Northwest	6.37
Northwest	3.53
North-Northwest	1.39

Note: Wind direction is the direction from which the wind is blowing.

Table 3-2b. Wind Speed Frequency Distribution

Wind Speed Interval (knots)	0-3	4-6	7-10	11-16	17-21	>21
Frequency (Percent)	24.6	32.8	25.6	14.7	1.9	0.4

3.1.1.2 Air Quality of the Project Area

The State of Arizona Department of Environmental Quality (ADEQ) and the United States Environmental Protection Agency (EPA) have established State and National Ambient Air Quality Standards (NAAQS) for "criteria pollutants" to protect the public health and welfare. The concentration of pollutants should not exceed the NAAQS in a particular area for various time-averaged periods. Criteria pollutants associated with the Miami mine are PM_{10} (particulates with an aerodynamic diameter of less than 10 microns), nitrogen oxides (NO_x), sulfur dioxide (SO_2), carbon monoxide (CO), and volatile organic compounds (VOC).

In addition to ambient air quality standards for criteria pollutants, the ADEQ has established Ambient Air Quality Guidelines (AAQG) for a large number of toxics to protect human health.

Small quantities of metals contained in the ore body and mine rock material in addition to sulfuric acid and gasoline, are potentially the toxics associated with the Cyprus Miami project. The NAAQS and AAQG for each criteria pollutant associated with the Cyprus/Miami operations are listed in **Table 3-3** below. Averaging periods represent an interval of time when the maximum emissions are allowed. The longer the averaging period, the lower the allowable emissions. To reach the average period emissions, actual emissions over any time period are divided by the number of averaging periods in the measurement period. For example, emissions measured for a month would be divided by 30 - 24 hour periods, or by 90 - 8 hour periods, or by 240 - 3 hour periods, or by 720 - 1 hour periods to arrive at the appropriate averaging period emissions.

The air quality of an area may be classified by the ADEQ as attainment, non-attainment, or unclassifiable. An attainment status means ambient levels of the pollutants are below the NAAQS. Non-attainment means these pollutants exceeded the NAAQS. Unclassifiable refers to areas where insufficient monitoring is available to adequately classify the area.

The Cyprus Miami proposed leach facility expansion project is within the Hayden/Miami Planning Area PM_{10} Non-Attainment Boundary. However, the ADEQ believes this designation should be changed. On November 10, 1994, ADEQ petitioned the EPA to redefine the boundaries of this non-attainment area because Hayden and Miami are in two different airsheds and monitoring in the Miami airshed area is in compliance for PM_{10}. The State Implementation Plan (SIP) for PM_{10} is in draft form and is on hold pending a decision from the EPA concerning the boundary change petition (Whitman & Company 1995b). The Miami area (T.1N., R.15E. and R.16E.) also has non-attainment status for SO_2. However, monitoring data since 1990 for SO_2 and since 1991 for PM_{10} **(Table 3-4)** show that the ambient air levels are well below the NAAQS for each pollutant. The locations where monitoring has been conducted are shown on **Figure 3-1**.

3.1.1.3 Regulatory Status of the Existing Cyprus Miami Operations

None of the ore at Cyprus Miami requires milling and concentrating (active physical and chemical processes where ore is crushed and ground, floated, and concentrated), or smelting (a thermal process where milled copper concentrates are converted to copper anodes). Thus, the proposed project is not related to the Miami smelter, which only handles copper sulfide concentrates produced by other Cyprus properties and transported to the smelter. This distinction is important because the mine and the smelter are separate sources from an air permitting and impact analysis point of reference. The Miami mine is a Metal Mining source (Standard Industrial Code 10), while the copper smelter is a Primary Metal Industry source (Standard Industrial Code 33). The smelter is classified as a major source (emissions greater than 100 tons per year (tpy) of a criteria pollutant) by the Clean Air Act and requires a Class I operating permit. The Miami mine is a separate source because it is not a support facility to the smelter. This is a distinction that the EPA uses to lump related facilities. Consequently, the Miami mine is not by itself a "categorical source", which must include fugitive emissions in determining the potential to emit pollutants (Arizona Administrative Code R18-2-101, 61.c).

Also, the mine is not part of a "Primary Copper Smelter" source, which must include fugitive emissions in determining potential to emit.

Table 3-3. National and Arizona Ambient Air Quality Standards and Guidelines ($\mu g/m^3$)

NATIONAL AMBIENT AIR QUALITY STANDARDS		
Pollutant	**Averaging Period**	**NAAQS**
PM_{10}	24-hour[1]	150
	Annual Average	50
Sulfur Dioxide	3-hour[2]	1,300
	24-hour[2]	365
	Annual Average	80
Nitrogen Oxides	Annual Average	50
Carbon Monoxide	8-hour[2]	40,000
	8-hour[2]	10,000
Ozone	8-hour[2]	235

ARIZONA AMBIENT AIR QUALITY GUIDELINES			
Pollutant	**Averaging Period**		
	1-hour	**24-Hour**	**Annual**
Arsenic (As)	3.2×10^{-1}	8.4×10^{-2}	2.3×10^{-4}
Cadmium (Cd)	1.7	1.1×10^{-1}	2.9×10^{-4}
Chromium (Cr)	11	3.8	---
Hexavalent Chromium (Cr VI)	1.1×10^{-1}	2.9×10^{-2}	8.0×10^{-5}
Lead (Pb)	1.5 per cal qtr	9.0×10^{-2}	---
Manganese (Mn)	25	1.6	---
Mercury (Hg)	6.0	4.0×10^{-1}	---
Nickel (Ni)	5.7	1.6	4.0×10^{-3}
Octane (C_8H_{18})	11,000	2,900	---
Selenium (Se)	6.0	1.6	---
Sulfuric acid (H_2SO_4)	22.5	7.5	---

Source: 40CFR 50.4-12 and ADEQ (1992)

[1] Not to be exceeded an average of once per year over three or more representative years of data.
[2] Not to be exceeded more than once per year.

$\mu g/m^3$ = micrograms of pollutant per cubic meter of air

Table 3-4. Ambient SO_2 and PM_{10} Measurements in the Project Area

Monitoring Site Locations (Legal Description)	Pollutant	Year	Annual Average ($\mu g/m^3$)	Percent of NAAQS (%)	3-Hr Average ($\mu g/m^3$)	Percent of NAAQS (%)	24-Hr Mean ($\mu g/m^3$)	Percent of NAAQS (%)
Jones Ranch NW¼ NW¼ SE¼ Section 31 T1N R15E (5/8 mile south of Miami)	SO_2	1993	12	1[illegible].0	730	56.1	132	36.2
		1993	15	18.7	890	68.5	100	43.8
		1992	8	7.5	537	41.3	95	26.0
		1993	1	8.7	803	61.8	120	32.9
		1993	8	10.0	527	40.5	166	45.5
		1995	8	10.0	433	33.3	122	33.4
Wheatfield/Burch Pump Station NE¼SW¼NE¼ Section 9 T1N R15E (2.5 miles northeast of Smelter)	SO_2	1993	2	2.5	87	6.7	1[illegible]	3.0
		1993	0	0.0	53	4.1	10	2.7
		1993	0	0.0	23	1.8	8	2.2
		1993	1	1.2	40	4.1	5	1.4
		1993	0	0.0	57	4.1	11	3.0
		1995	1	1.2	53	4.1	21	5.7
Town Site NE¼NW¼NW¼ Section 30 T1N R15E (in Miami by Catholic Church)	SO_2	1990	4	[illegible].0	433	33.1	54	14.8
		1991	5	6.2	890	68.5	64	17.5
		1993	4	[illegible].0	383	29.5	52	14.2
		1991	1	[illegible].0	237	18.2	58	15.9
		1993	1	[illegible].0	273	21.0	32	11.5
		1995	5	7.5	280	21.5	56	15.9
Golf Course SE¼NW¼NE¼ Section 21 T1N R15E (Golf Course north of intersection of U.S HW 60/70 and State Road 88)	PM_{10}	1991	N/A	N/A	—	—	57	38.0
		1991	24	48.0	—	—	57	33.3
		1993	26	52.0	—	—	59	39.3
		1994	26	52.0	—	—	63	42.0
		1995	31	62.0	—	—	74	49.3
Ridgeline SW¼NW¼SW¼ Section 29 T.1N. R.15E. (¼ mile southeast of Miami)	PM_{10}	1993	N/A	N/A	-	-	100	66.7
		1992	14	28.0	-	-	32	21.3
		1993	14	28.0	-	-	29	19.3
		1991	14	28.0	-	-	33	22.0
		1995	15	30.0	-	-	10	32.6
Carlota Mine Site NW¼ Section 31 T.1N. R.14E.	PM_{10}	1992, 4th	21.7	43.4	-	-	-	-
		1993 1st and 2nd Qtrs.	20.0	40.0	—	—	-	-

Source: ADEQ 1995, USDA Forest Service 1995

Cyprus Miami Mining Corporation
Leach Facility Expansion EIS

Figure 3-1

AIR QUALITY MONITORING SITE LOCATION MAP

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3.1.1.4 Current Fugitive Emissions

The Cyprus Miami operating permit application contains a detailed inventory for fugitive and point source emissions. By definition, fugitive emissions are those that do not reasonably pass through a stack, chimney, vent or any other functionally-equivalent opening. Point source emissions are released through a stack, chimney, vent or any other functionally-equivalent opening. Examples of fugitive emissions are road dust generated by traffic on unpaved roads or wind-generated dust off stockpiles. Emissions from each phase of the Cyprus Miami mining process are shown on **Tables 3-5a and 3-5b**. The current (1995) emissions are estimated using the 1993 inventory by scaling up to the 1995 production rate. This is a valid estimate because all emissions associated with surface mining processes are based on frequency of drilling and blasting, amount of material mined and transported, haul truck miles traveled, miscellaneous vehicle miles traveled, and disturbed acreage. The 1993 mining records indicated that 61.7 million tons of ore and waste rock were mined. In 1995, the total was 94.7 million tons. Therefore, the 1993 emission inventory (TRC 1994) was multiplied by a factor of 1.53 to obtain the 1995 emission inventory shown in **Table 3-5a**.

The vast majority of emissions at the Miami mine are fugitive dust emissions. These emissions result from routine mining activities, including the:

- initial drilling of ore and waste rock; blasting with ammonium nitrate-fuel oil (ANFO);
- loading of ore and waste rock by shovels into haul trucks;
- hauling ore to leach pads;
- hauling waste rock to waste rock disposal sites;
- dumping ore at leach pads and waste rock at disposal sites;
- light vehicle travel on unpaved roads; and
- wind erosion on disturbed areas.

Sulfuric acid mist fugitive emissions are generated when loaded strip solution from the solvent extraction plant is pumped into the electrowinning tanks for copper recovery. The sulfuric acid mist emissions occur at cells used at the tankhouse. These emissions were estimated (CMMC 1994) using measurements made at another copper tankhouse in Arizona that used a forced air ventilation system. Emissions were found to be approximately 0.000157 pounds per hour per square foot (CMMC 1994). Multiplying this normalized sulfuric acid emission rate by the total cell square footage yields a conservative estimate of 21.21 tpy (**Table 3-5b**).

Sulfuric acid mist emissions may also be generated when solutions bearing sulfuric acid are sprinkled over the leach pads. The solutions can contain up to 225 grams per liter (gpl) (17 percent) sulfuric acid in the form of a cure applied for up to 5 days or may contain as low as 9.4 gpl (0.8 percent) sulfuric acid in the form of a rinse applied for up to 120 days. The solutions are distributed through "wobblers" at rates of 0.003 to 0.0047 gallons per minute per square foot (gpm/ft^2). The wobblers are designed to distribute the solution in an approximate

50-foot diameter with droplet sizes of three to six millimeters. This droplet size and rate of application are designed to minimize misting, wind drift, and evaporative losses.

Table 3-5a. Cyprus Miami Annual Emissions

1995 Fugitive PM_{10} Emissions (Tons per Year)				
Mining Activity	**'93 Uncontrolled Emissions**	**'95 Uncontrolled Emissions**	**Control (Efficiency)**	**'95 Controlled Emissions**
Drilling	3.08	4.72	Shrouding around drill shaft (50%)	2.36
Blasting	25.05	38.44	None	38.44
Wind Erosion	31.41	48.21	None	48.21
Shovel Loading	8.72	13.38	None	13.38
Haul Trucks and Heavy Equipment*	1861.3	2854.93	Chemical or water application as needed (50%)	1427.46
Light Vehicles	607.46	923.36	Chemical or water application as needed (50%)	461.68
Ore/Waste Rock Transfer	8.72	13.38	None	13.38
Annual Total Fugitive Emissions	2545.74	3896.42		2004.91

* Haul road emissions were calculated with the Unpaved Road emission factors from Document AP-42 (US EPA 1993).

Source: TRC 1994

Table 3-5b. Other 1995 Emissions (Tons per Year)

Mining Activity	Pollutant	Type	1993 Emissions	1995 Emissions	Controls	1995 Controlled Emissions
Solvent Extraction/Electrowinning						
Diluent Storage	VOC	Point	0.04	0.04	None	0.04
Grunge Storage	VOC	Point	0.01	0.01	None	0.04
Organic Storage	VOC	Point	7.63	7.63	None	7.63
Extraction	VOC	Fugitive	409.31	409.31	None	409.31
EW Tankhouse						
Boilers (continuous natural gas fueled)	PM_{10}	Point	3.89	3.89	None	3.89
	CO	Point	9.95	9.95	None	9.95
	NO	Point	39.80	39.80	None	39.80
	SO_2	Point	0.17	0.17	None	0.17
Electrowinning	Sulfuric Acid Mist	Fugitive	21.21	21.21	None	21.21
Miscellaneous						
Gasoline Storage	VOC	Point	12.81	12.81	None	12.81
Diesel Storage	VOC	Point	0.07	0.11	None	0.11
Mist from Wobblers at Leach Pad*	Sulfuric Acid Mist	Fugitive	Unknown	Unknown	None	Unknown
Total Point Source Emissions	VOC		20.56	27.45	None	27.45
	PM_{10}		3.89	3.89	None	3.89
	CO		9.95	9.95	None	9.95
	NO		39.80	39.80	None	39.80
	SO_2		0.17	0.17	None	0.17
Total Fugitive Emissions	VOC		409.31	409.31	None	409.31
	Sulfuric Acid Mist		21.21	21.21	None	21.21

* Sulfuric acid mist resulting from sprinkling acid over leach pad is unknown. Size of droplets and application rates are manipulated to minimize mist.

Source: Cyprus Miami Operating Permit Application on file at ADEQ (TRC 1994).

A solvent extraction grade of kerosene is used as an organic diluent (diluting agent) in solvent-extraction operations. Fugitive VOC emissions occur during extraction and in subsequent handling of leachate solution streams which contact the kerosene diluent. Fugitive emissions of 409 tpy (**Table 3-5b**) were calculated by mass balance (TRC 1994).

Parts and equipment are cleaned with methylene chloride. No solvent recycling or recovery is conducted. Therefore, solvent usage is assumed equal to solvent emissions. Usage numbers for 1993 were determined from the Cyprus inventory control and scaled up to current levels of operation. The fugitive methylene chloride emissions are also shown on **Table 3-6**.

3.1.1.5 Current Point Source Emissions

The Miami mine has the following point-source emissions (**Table 3-5b**):

- tank vents associated with the solvent extraction operation;
- diesel and gasoline fixed-roof tanks;
- two fossil-fueled boilers used to heat solution at the tankhouse; and
- smaller tank vents, generators, and heaters that qualify as insignificant sources.

The tankhouse boiler produces the only significant point source emissions. With continuous use, the natural gas-fired boiler emits 39.8 tpy of NO_x, plus smaller amounts of CO, PM_{10}, and SO_2. Smaller levels of VOCs are emitted from storage of gasoline (12.81 tpy) and solvent extraction (7.63 tpy) (**Table 3-5b**).

3.1.1.6 Current Hazardous Air Pollutant Emissions

The fugitive hazardous air pollutants, shown on **Table 3-6**, were calculated using the mass fraction of the individual chemicals found in kerosene.

Table 3-6. Cyprus Miami Facilities Current Emissions of Hazardous Air Pollutants

Hazardous Air Pollutant	Fugitive Source Solvent Extraction (tpy)	Fugitive Source Tankhouse Cleaning (tpy)	Point Source Gasoline Storage (tpy)	Total Emissions (tpy)
Benzene	0.01		0.[illegible]	0.15
Xylenes	1.53			1.53
Toluene	0.09		0.12	0.21
Naphthalene	0.28		0.05	0.33
Ethyl Benzene	0.28		0.01	0.29
Methylene Chloride		2.51		2.51
O-Xylene			0.01	0.01
Totals	2.18	2.51	0.33	5.03
Total Fugitive Emissions (tpy)			4.69	
Total Point Source Emissions (tpy)			0.33	

Source: Cyprus Miami Operating Permit Application on file at ADEQ (TRC 1994).

3.2 GEOLOGY & MINERALS

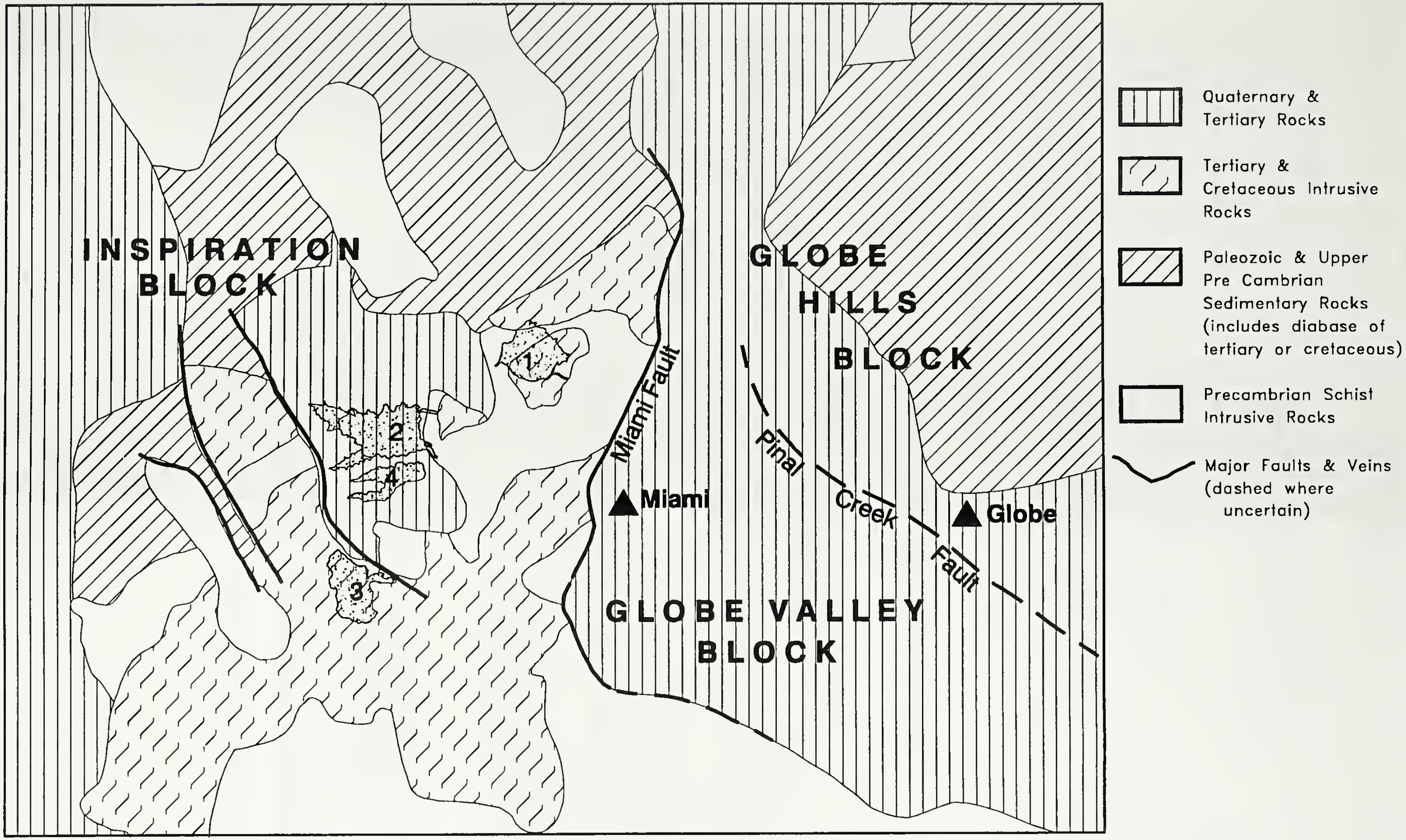
The proposed Cyprus Miami expansion facilities would be located in the foothills of the Pinal Mountains, immediately northwest of the town of Miami in Gila County, and about 90 miles east of Phoenix, Arizona. The Globe-Miami Mining District has been explored and mined intermittently since 1864 (Central Arizona Association of Governments [CAAG] 1983; Ransome 1903). Large-scale mining activities boomed in the early 1900s due to the development of a profitable method of working low-grade copper ore bodies. Most of the copper mining activity has occurred in a region that extends from Copper Gulch on the east to the Gila County line on the west, and from Sleeping Beauty Mountain on the north to Bloody Tanks Wash on the south (**Figure 1-1**). At one time, the district was considered one of the four largest mineral producers in the world (CAAG 1983).

Copper accounts for over 98 percent of the district's metal value, with 80 percent of the copper derived from large low-grade, disseminated or porphyry-type deposits (Peterson 1962). These deposits are related to a single period of mineralization that is younger than the Schultze granite and related intrusions of Late Cretaceous to Early Tertiary age and older than the Whitetail conglomerate and dacite of Tertiary age. The disseminated copper deposits in the district are similar in character. The copper deposits are typically irregular, tabular bodies with an upper, nearly-barren leach cap. Downward percolating groundwater has redeposited the leached copper in blanket-like zones of supergene enrichment.

3.2.1 Regional Setting

The project site lies near the southern margin of the Transition Zone physiographic province. This province extends from the northwest to southeast corners of Arizona, separating the Colorado Plateau to the northeast from the Basin and Range physiographic province to the southwest. The Transition Zone is characterized by rugged mountains of Precambrian igneous and metamorphic rock with erosional remnants of Paleozoic sediments, overlain by sedimentary and volcanic rocks of Quaternary and Tertiary age (Scarborough and Wilt 1979).

The Globe-Miami Mining District is dissected by the broad Globe Valley. The project area is situated on the southwest side of the valley in the northwestern foothills of the Pinal Mountains. The area to the northeast of Globe Valley, the Globe Hills, is part of the lower foothills of the Apache Mountains (**Figure 3-2**). The structural features of the Upper Precambrian and younger formations are the product of block faulting and displacement during the Late Cretaceous through Early Tertiary. Portions of three major structural blocks occur within the Globe-Miami Mining District; the Globe Valley, Globe Hills, and Inspiration blocks. The Globe Valley block is a downdropped graben between the Globe Hills block on the east and the Inspiration block on the west. The eastern and western boundaries of the Globe Valley block are the Pinal Creek and Miami faults, respectively. Portions of the Globe Valley basin are filled with more than 4,000 feet of Gila conglomerate which is the principal groundwater aquifer for both domestic and industrial use (Peterson, 1962). This aquifer is well removed from the proposed



Proposed Facilities

1 GMC Leach Facility
2 BL Leach Facility
3 Oxhide Leach Facility
4 Barney Waste Rock Facility

N

0 2 4
Scale (mi.)

Cyprus Miami Mining Corporation
Leach Facility Expansion EIS

Figure 3-2

REGIONAL GEOLOGIC SETTING

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mine facilities. The Globe Hills block consists largely of rocks of the Apache Group and Troy quartzite. These rock units are intruded with numerous dikes and sills of diabase and are overlain by Gila conglomerate in the southwestern portion of the block. The Inspiration block is the most geologically-complex structural feature. It contains every geologic unit of the local stratigraphic column and all of the intrusive and volcanic rocks of the district. The northwest portion of the block is largely composed of Upper Precambrian and Paleozoic sedimentary rocks intruded by diabase. The southeast portion of the block is dominated by Pinal schist and intrusive crystalline rocks. The Inspiration block contains most of the known disseminated copper deposits in the district (Peterson, 1962). The proposed mine facilities are located in the Inspiration block.

3.2.2 Geologic History

The geologic history of the Miami-Globe district is summarized in **Table 3-7**. **Table 3-8** presents a grouping of the main rock types within the district.

Table 3-7. Geologic History of the Miami-Globe District

Geologic Time[1]	Geologic Processes
Early Precambrian ~1650 to 1730	Dynamic and thermal metamorphism of a thick sequence of shale and sandstone during the Mazatzal Revolution to form the Pinal schist, a basal schistose rock underlying much of the region.
Early Precambrian ~1650	Intrusion of Madera diorite, Ruin granite and dioritic plutons into the Pinal schist during the later stages of the Mazatzal Revolution, followed by a long period of erosion.
Late Precambrian ~1000 to 1500	Deposition of the Apache Group, about 1,200 feet of conformable sediments with one or more vesicular basalt flows, on an ancient peneplain.
Paleozoic 300 to 500	Deposition of at least 2,000 feet of sandstone and limestone by advancing and retreating seas.
Late Cretaceous to Early Tertiary 60 to 80	Intrusion of igneous plutons accompanied by extensive faulting and deformation, climaxed by widespread copper mineralization.
Tertiary 15 to 40	Periods of erosion with local deposition of at least 500 feet of Whitetail conglomerate, followed by two periods of eruption resulting in widespread deposition of dacite.
Tertiary 1 to 10	Periods of erosion and accumulation of coalescing alluvial fan deposits to form the Gila conglomerate with a local thickness exceeding 4,000 feet.
Pleistocene <1	Faulting, regional uplift and erosion with local secondary enrichment of ore bodies.

[1] Geologic time in millions of years before present.
Source: Peterson 1962.

Table 3-8. Geologic Units of the Globe-Miami District

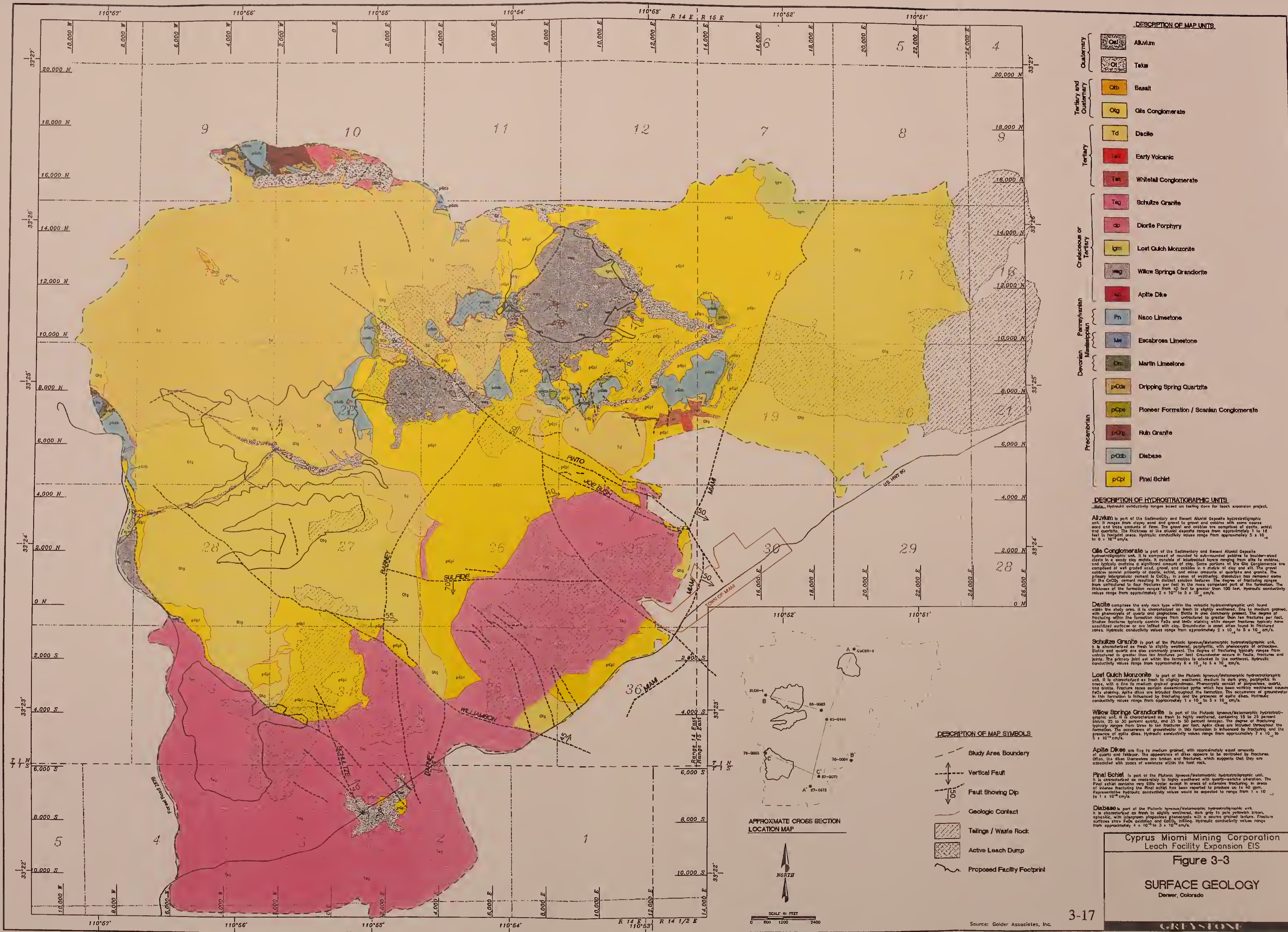
QUATERNARY & TERTIARY SEDIMENTARY & VOLCANIC ROCKS
Alluvium
Basalt
Gila Conglomerate
Dacite
Early Volcanics
Whitetail Conglomerate
TERTIARY & CRETACEOUS INTRUSIVE ROCKS
Schultze Granite
Diorite Porphyry
Lost Gulch Monzonite
Willow Springs Granodiorite
PALEOZOIC SEDIMENTARY ROCKS
Naco Limestone
Escabrosa Limestone
Martin Limestone
UPPER PRECAMBRIAN ROCKS
Diabase
Troy Quartzite
Basalt
Mescal Limestone
Dripping Springs Quartzite
Barnes Conglomerate
Pioneer Formation
Scanlan Conglomerate
LOWER PRECAMBRIAN SCHIST & INTRUSIVE ROCKS
Ruin Granite
Madera Diorite
Pinal Schist

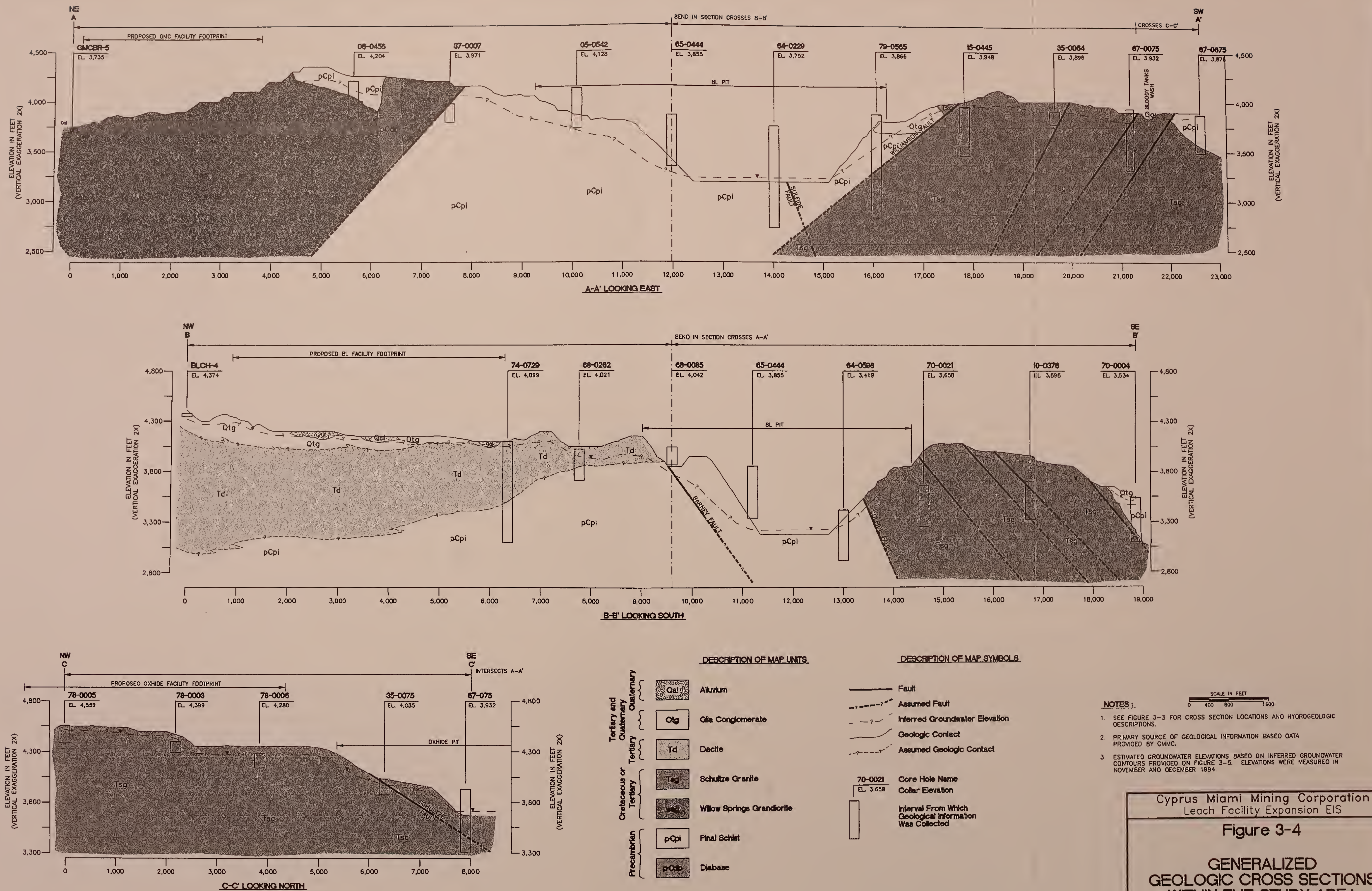
3.2.3 Local Geologic Conditions

3.2.3.1 Geologic Units Within Study Area

The surficial geology of the study area and the locations of geologic cross sections are presented in **Figure 3-3**. Generalized geologic cross sections within the study area are presented in **Figure 3-4**.

Four rock units dominate the study area; Pinal schist, Schultze granite, Gila conglomerate, and dacite. The Precambrian Pinal schist is exposed extensively in the central and north central portions of the study area. There are no significant outcrops of the Pinal schist within the footprint of the proposed leach and overburden facilities. The rock ranges from micaceous


DESCRIPTION OF MAP UNITS
Quaternary
Qal Alluvium
Qt Talus
Tertiary and Quaternary
Qtb Basalt
Qtg Gila Conglomerate
Tertiary
Td Dacite
Tev Early Volcanic
Twt Whitetail Conglomerate
Cretaceous or Tertiary
Tsg Schultze Granite
dp Diorite Porphyry
lgm Lost Gulch Monzonite
wsg Willow Springs Grandiorite
ap Aplite Dike
Pennsylvanian
Pn Naco Limestone
Mississippian
Me Escabrosa Limestone
Devonian
Dm Martin Limestone
Precambrian
pCds Dripping Spring Quartzite
pCpe Pioneer Formation / Scanlan Conglomerate
pCrg Ruin Granite
pCdb Diabase
pCpl Pinal Schist
DESCRIPTION OF HYDROSTRATIGRAPHIC UNITS
Note: Hydraulic conductivity ranges based on testing done for leach expansion project.
Alluvium is part of the Sedimentary and Recent Alluvial Deposits hydrostratigraphic unit. It ranges from clayey sand and gravel to gravel and cobbles with some coarse sand and trace amounts of fines. The gravel and cobbles are comprised of dacite, schist and quartzite. The thickness of the alluvial deposits ranges from approximately 1 to 16 feet in footprint areas. Hydraulic conductivity values range from approximately 5 x 10 to 6 x 10 cm/s.
Gila Conglomerate is part of the Sedimentary and Recent Alluvial Deposits hydrostratigraphic unit. It is composed of rounded to sub-rounded pebbles to boulder-sized clasts in a sandy clay matrix. It consists of interbedded layers ranging from silts to cobbles, and typically contains a significant amount of clay. Some portions of the Gila Conglomerate are comprised of well graded sand, gravel, and cobbles in a matrix of clay and silt. The gravel cobbles consist primarily of dacite, schist, and minor amounts of quartzite and granite. The primary intergranular cement is $CaCO_3$. In zones of weathering, dissolution has removed some of the $CaCO_3$ cement resulting in distinct solution features. The degree of fracturing ranges from unfractured to four fractures per foot in the more competent part of the formation. The thickness of the formation ranges from 40 feet to greater than 100 feet. Hydraulic conductivity values range from approximately 2×10^{-7} to 5×10^{-4} cm/s.
Dacite comprises the only rock type within the volcanic hydrostratigraphic unit found within the study area. It is characterized as fresh to slightly weathered, fine to medium grained, with phenocrysts of quartz and plagioclase. Biotite is also commonly present. The degree of fracturing within the formation ranges from unfractured to greater than ten fractures per foot. Shallow fractures typically contain FeOx and MnOx staining while deeper fractures typically have unoxidized surfaces or are infilled with clay. Groundwater is most often found in fractured zones. Hydraulic conductivity values range from approximately 2 x 10 to 5 x 10 cm/s.
Schultze Granite is part of the Plutonic Igneous/Metamorphic hydrostratigraphic unit. It is characterized as fresh to slightly weathered, porphyritic, with phenocrysts of orthoclase. Biotite and quartz are also commonly present. The degree of fracturing typically ranges from unfractured to greater than ten fractures per foot. Groundwater occurs in faults, fractures and joints. The primary joint set within the formation is oriented to the northeast. Hydraulic conductivity values range from approximately 6 x 10 to 5 x 10 cm/s.
Lost Gulch Monzonite is part of the Plutonic Igneous/Metamorphic hydrostratigraphic unit. It is characterized as fresh to slightly weathered, medium to dark gray, porphyritic in areas, with a fine to medium grained groundmass. Phenocrysts consist of plagioclase, quartz, and biotite. Fracture faces contain disseminated pyrite which has been variably weathered causing FeOx staining. Aplite dikes are intruded throughout the formation. The occurrence of groundwater in this formation is influenced by fracturing and the presence of aplite dikes. Hydraulic conductivity values range from approximately 1 x 10 to 5 x 10 cm/s.
Willow Springs Grandiorite is part of the Plutonic Igneous/Metamorphic hydrostratigraphic unit. It is characterized as fresh to highly weathered, containing 15 to 25 percent biotite, 25 to 30 percent quartz, and 35 to 50 percent feldspar. The degree of fracturing typically ranges from three to ten fractures per foot. Aplite dikes are intruded throughout the formation. The occurrence of groundwater in this formation is influenced by fracturing and the presence of aplite dikes. Hydraulic conductivity values range from approximately 7 x 10 to 5 x 10 cm/s.
Aplite Dikes are fine to medium grained, with approximately equal amounts of quartz and feldspar. The appearance of dikes appears to be controlled by fractures. Often, the dikes themselves are broken and fractured, which suggests that they are associated with zones of weakness within the host rock.
Pinal Schist is part of the Plutonic Igneous/Metamorphic hydrostratigraphic unit. It is characterized as moderately to highly weathered with quartz-sericite alteration. The Pinal schist contains very little water except in areas of extensive fracturing. In areas of intense fracturing the Pinal schist has been reported to produce up to 40 gpm. Representative hydraulic conductivity values would be expected to range from 1 x 10 to 1 x 10 cm/s.
Diabase is part of the Plutonic Igneous/Metamorphic hydrostratigraphic unit. It is characterized as fresh to slightly weathered, dark gray to pale yellowish brown, aphanitic, with intergrown plagioclase phenocrysts with a course grained texture. Fracture surfaces show FeOx oxidation and $CaCO_3$ infilling. Hydraulic conductivity values range from approximately 4 x 10 to 3 x 10 cm/s.
DESCRIPTION OF MAP SYMBOLS
Study Area Boundary
Vertical Fault
Fault Showing Dip
Geologic Contact
Tailings / Waste Rock
Active Leach Dump
Proposed Facility Footprint
APPROXIMATE CROSS SECTION LOCATION MAP
NORTH
SCALE IN FEET
0 600 1200 2400
PINTO
JOE BUSH
MIAMI
SULFIDE
BARNEY
WILLIAMSON
SCHULTZE
TOWN OF MIAMI
US HWY 60
Range 14 East
Range 15 East
R 14 E R 15 E
R 14 1/2 E
T 1 N
T 1 S
Source: Golder Associates, Inc.
Cyprus Miami Mining Corporation
Leach Facility Expansion EIS
Figure 3-3
SURFACE GEOLOGY
Denver, Colorado
GREYSTONE



NOTES:

1. SEE FIGURE 3-3 FOR CROSS SECTION LOCATIONS AND HYDROGEOLOGIC DESCRIPTIONS.
2. PRIMARY SOURCE OF GEOLOGICAL INFORMATION BASED DATA PROVIDED BY CMMC.
3. ESTIMATED GROUNDWATER ELEVATIONS BASED ON INFERRED GROUNDWATER CONTOURS PROVIDED ON FIGURE 3-5. ELEVATIONS WERE MEASURED IN NOVEMBER AND DECEMBER 1994.

Cyprus Miami Mining Corporation
Leach Facility Expansion EIS

Figure 3-4

GENERALIZED GEOLOGIC CROSS SECTIONS WITHIN THE STUDY AREA

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Source: Golder Associates, Inc.

quartzite, to well-foliated schist, to poorly-foliated gneiss. Regional foliation of the schist trends northeast and dips about 45 degrees to the southeast (Golder Associates Inc., 1995e).

The Schultze granite is exposed extensively in the southern portion of the study area. The Schultze granite typically has larger crystals of feldspar minerals or quartz in a fine-grained groundmass of quartz, feldspar, mica, and other mineral groups. The granite appears to underlie all of the proposed Oxhide leach facility, but is not present at the other leach and overburden sites.

The Gila conglomerate is extensively exposed throughout much of the study area. The conglomerate underlies all of the Barney overburden facility site and the southwestern one-half of the BL leach facility site. The Gila conglomerate consists of interfingering alluvial fans composed of material from the surrounding highlands. The primary cementing agent that holds the rock particles together is calcium carbonate. The cement has dissolved in some locations resulting in local cavities within the rock (Golder Associates Inc., 1995e).

The dacite is comprised of welded volcanic fragments that once covered the entire Globe-Miami district. The unit locally reaches a thickness of at least 700 feet within the study area. The dacite presently is exposed in the northwest portion of the study area and underlies the northeastern half of the BL leach facility. The dacite was deposited after the Whitetail conglomerate, but before the Gila conglomerate. Therefore, the dacite is located between these two conglomerate layers and represents a period of volcanic activity within the cycle of conglomerate deposition (Peterson, 1962).

Five additional rock units occur within the study area, but much less extensively than the units described above. The five additional units are the Willow Springs granodiorite, Lost Gulch quartz monzonite, aplite dikes, diabase, and Whitetail conglomerate.

3.2.3.2 Geology of Proposed Facility Sites

An overview of the geology at each of the proposed facilities is provided below:

- Oxhide Leach Facility. The proposed Oxhide leach facility is underlain almost entirely by the Schultze granite (**Figures 3-3 and 3-4**). The Schultze granite appears to extend to depths in excess of 500 feet beneath the facility. The granite encountered in drill holes at the proposed Oxhide facility is characterized as fresh to slightly weathered and the degree of fracturing ranges from unfractured to greater than 10 fractures per foot (Golder Associates Inc. 1995e).

- BL Leach Facility. The northern portion of the proposed leach facility is underlain by dacite, while the southern portion is underlain by Gila conglomerate (**Figures 3-3 and 3-4**). Alluvial deposits within the footprint of the proposed facility are primarily limited to the valley floor of Webster Gulch and Little Pinto Canyon (Golder Associates Inc., 1995e).

Based on exploratory drilling results, the Gila conglomerate has a thickness of greater than 100 feet below the BL disturbance area and mainly occurs as bedded deposits of silt- to cobble-sized material with significant clay content (Golder Associates Inc., 1995e).

Based on geologic cross sections prepared by Golder Associates Inc. (1995e), the dacite varies from several hundred to greater than 1,000 feet in thickness beneath the proposed BL facility. The dacite at the proposed BL facility is characterized as fresh to slightly weathered and fine- to medium-grained with larger crystals of quartz and other minerals (Golder Associates Inc., 1995e).

- <u>GMC Leach Facility.</u> The proposed GMC leach facility is underlain almost entirely by the Willow Springs granodiorite, which appears to extend to depths in excess of several hundred feet beneath the proposed leach pad (**Figures 3-3 and 3-4**). The Willow Springs granodiorite is characterized as fresh to highly weathered (Golder Associates Inc., 1995e).

  Pinal schist is present in the northwestern portion of the proposed GMC site. A minor amount of basalt rock is present in the southwest portion of the facility footprint, and light-colored rock dikes intrude the Willow Springs granodiorite (quartz rock) in the central portion of the proposed site.

- <u>Barney Waste Rock Facility.</u> The proposed Barney waste rock facility is entirely underlain by Gila conglomerate. Based on Borehole No. BLO-1, located within the central portion of the proposed facility, the Gila conglomerate is relatively thin. The borehole encountered approximately 35 feet of overburden material, several feet of clay, and about 8 feet of colluvium, followed by slightly weathered Pinal schist. Based on the results of the drilling and the cross sections developed by Golder Associates Inc. (1995e), it appears that the Gila conglomerate is on the order of about 10 to 100 feet or more in thickness and is underlain by Pinal schist and possibly dacite.

3.2.3.3 Geologic Structure

The dominant fault pattern in the study area probably was established during Precambrian time (**Table 3-8**). The major structural features within the study area are shown on (**Figure 3-4**). Northwest-trending faults dip steeply to the northeast and appear to have had mostly horizontal movement. These faults appear to be the youngest structures in the study area (Golder Associates Inc., 1995e). North-trending faults, including the Barney fault, are likely the second-most recent structures because they are cut only by the northwest-trending faults, while intersecting other structures. These faults dip moderately to steeply to the east and appear to have had mostly vertical movements of about 100 to 600 feet. Northeast-trending faults are parallel to the regional foliation, dip moderately to the southeast and have had mostly vertical movement (Golder Associates Inc., 1995e).

The Sulfide fault is the only major structure with an east-west trend in the study area. The Sulfide fault is located on the south side of the BL pit and dips steeply to the south, forming the contact between granite on the south and schist on the north. The Sulfide fault follows the oldest structural trend in the study area (Golder Associates Inc., 1995e). Several sets of low- to moderately-dipping structures strike northwest to east-west and generally dip to the south.

3.2.4 Geotechnical Considerations

3.2.4.1 Seismicity

The study area is located in a tectonic area characterized by a low level of recorded seismic activity during historic time. Geologic studies of fault activity and tectonic flux indicate that this period of limited seismicity began well before the earliest earthquake records (Pearthree et al., 1983).

Studies have been conducted to identify the location and seismic significance of potentially-active faults in the Southern Basin and Range province (Pearthree et al., 1983) and to evaluate the potential influence of active faults on Cyprus Miami facilities (Sergent, Hauskins & Beckwith, 1981). A design criteria of an effective peak ground acceleration (EPGA) of 0.10 of unit gravity (g) was recommended as a result of these studies. The most recent seismic appraisal for the Cyprus Miami facilities was completed by Dr. Charles Glass (Glass, 1992). Dr. Glass states that the probability of occurrence of an earthquake event that would produce an EPGA of 0.10g is less than 0.25 percent within the next 200 years.

3.2.4.2 Geologic Hazards

Landslides, debris flows or other large-scale surficial geologic processes that could pose a hazard to the construction, operation, and closure of the proposed facilities do not appear to exist on or in the vicinity of the four sites under consideration. The risk of encountering these types of hazards appears to be low, in that the sites are underlain by relatively competent bedrock with limited thicknesses of unconsolidated materials overlying bedrock (Golder Associates Inc., 1995a). Conditions in the bedrock that could potentially influence facility performance are associated with small, abandoned underground mine workings, the existence of springs and seeps of limited yield, and the presence of saturated alluvium.

Site-specific studies identified five adits within the footprint of the proposed BL facility and six within the GMC footprint of the facility area (Golder Associates Inc., 1995b). These mine workings may pose, to varying degrees, a threat of collapse and localized settlement of the overlying engineered fill and liner system.

All the potential heap leach facility expansion locations are located in steep and rugged mountainous terrain. These areas are dominantly characterized by exposed bedrock or contain a thin veneer of alluvial/colluvial soils over bedrock, which economically and technically

prohibit conventional site preparation construction techniques (Golder Associates Inc. 1996a). Whenever terrain is steeper than 2.5H:1V, it is not geotechnically possible to construct a liner system. Even with less steep slopes, such sites require extensive foundation fill and regrading before a liner system could be installed.

The principal drainage paths and arroyos of the facility disturbance sites are underlain by variable thicknesses of unconsolidated alluvium. Unlike the competent bedrock units, these limited alluvial deposits can consolidate if subjected to the stress of large load. In addition, portions of the alluvium appear to be saturated, further reducing the inherent strength of the material. To alleviate the potential development of a hydraulic head within the foundation fills, a foundation underdrain system would be constructed beneath the foundation fills, as discussed in Section 2.4.2.1.

3.2.5 Condemnation Drilling Results

Drilling results were reviewed for 43 condemnation boreholes located within and adjacent to the proposed facilities (CMMC 1995a). The information included the borehole locations, geologic units encountered, assay results and a site plan showing the borehole locations. Low concentrations of copper were detected in most of the assayed samples, along with low levels of molybdenum, lead, and zinc. Low concentrations to trace amounts of silver and trace amounts of gold were detected in samples obtained from condemnation boreholes located within or adjacent to the proposed GMC leach facility site.

Assuming that economic-grade copper ore generally contains greater than 0.15 percent copper, only two boreholes encountered mineralized material. This mineralization was encountered south of the proposed Barney overburden site, with intermittent zones of copper concentrations ranging from 0.17 to 0.56 percent at depths between about 1,500 and 2,400 feet.

3.2.6 Geochemistry of Mine Materials

Ore would be mined from the BL and TJ pits and placed on lined leach pads for copper extraction. The Oxhide pit is currently inactive. Waste rock material removed from the pits would be used to build the foundations of the proposed leach pads and also would be placed in the Barney waste rock site. Fine-grained, mill tailings would be used as a low-permeability cushion layer below the geomembrane layer of the leach pads.

The chemical properties of each of these materials (ore, waste rock and tailings) were characterized to evaluate their potential for impacts to the environment. A detailed description of the testing procedures and the geochemical testing results are presented in the Materials Characterization Program Report prepared by Golder Associates Inc. (1995f), and are summarized below. Impacts from use of these materials are discussed in Chapter 4. The Materials Characterization Program Report was prepared in order to identify those materials with the potential for acid generation. Those materials can be flagged in the field and mixed with

neutralizing material or be isolated within the waste rock dumps. Using either method, the objective is to prevent the generation of acid rock drainage.

The ore types that were tested included mineralized oxide schist, sulfide schist, granite porphyry and Schultze granite. The results of the ore characterization suggest that these materials, when exposed to water, have a significant potential for generating leachate with a low pH and high metals content even after active leaching of the ore has stopped (Golder Associates Inc., 1995f).

Forty-two samples of waste rock, including dacite, Gila conglomerate, Schultze granite, and Pinal schist, were submitted for Acid-Base Accounting (ABA) tests. The ABA testing indicated that each of the rock types tested have, on average, a greater capacity to neutralize acid than to generate acid (Golder Associates Inc., 1995f).

Ten tailings samples were collected and submitted for geochemical testing, which included ABA, pH, and leachability testing. The ABA testing indicated a potential for acid generation, the pH values ranged from slightly acidic to slightly alkaline, and the leaching test indicated a relatively low mobility for most metals (Golder Associates Inc., 1995f).

3.3 WATER RESOURCES

3.3.1 Groundwater

3.3.1.1 Regional Groundwater Setting

3.3.1.1.1 Regional Groundwater Quantity

Three types of groundwater aquifers are present in the region: 1) igneous/metamorphic, 2) volcanic, and 3) sedimentary/alluvial. The igneous/metamorphic unit consists primarily of the Pinal schist and the Schutze granite; the volcanic unit consists primarily of dacite. These rocks contain small quantities of water in faults and fractures that occurred after the formation of the rock. Although the quantity of groundwater yielded to wells in these rocks depends upon the number and size of fractures that the well intercepts, yields to wells are often less than 5 gallons/minute (gpm). In some areas, the dacite acts as a barrier to groundwater flow. The majority of groundwater in the region is located in the sedimentary/alluvial unit. This unit consists of, from older to younger, Gila conglomerate, Gila conglomerate detritus, and unconsolidated alluvial fill in stream channels. Well yields range from less than 5 gpm to more than 150 gpm (Golder Associates Inc., 1995e).

Recharge of watersheds within the region is derived primarily from infiltration of rainfall and, to a lesser extent, snowmelt. The regional groundwater flow occurs locally from higher elevations in the mountains to lower elevations in the valley floor. Groundwater flow direction is to the north/northwest in the sedimentary/alluvial aquifer. Crystalline rocks do not comprise an aquifer unit with a regional flow system. Regional discharge occurs along the perennial reach

of Pinal Creek approximately four miles upstream of the Inspiration Dam (a point approximately 12 miles downstream from the project area). In the area where groundwater discharges to the surface, the Gila conglomerate and alluvial deposits narrow and become thinner. Baseflow within the lower Pinal Creek alluvial aquifer is estimated to range from 2,960 gpm to 4,000 gpm.

Based on a regional well survey (53 square miles) of ADWR-registered wells, 44 percent of the registered wells are used for industrial, mining, and agricultural purposes. Thirty-two percent of the wells are used for groundwater monitoring, nine percent are used for domestic purposes, and 15 percent have no specified use. Yields of wells within the Pinal Creek watershed range from less than 1 to 2,000 gpm. Seventy-seven wells located in the Pinal Creek watershed are industrial-use wells. Appendix G of the Groundwater Baseline Report (Golder Associates Inc. 1995e) provides information on well ownership.

3.3.1.1.2 Regional Groundwater Quality

Groundwater quality within the region is variable as a result of both natural and man-made influences. Groundwater composition in the vicinity of the study area ranges from calcium-sulfate type to calcium-bicarbonate type. The deep groundwater within the Gila conglomerate is low to moderate in total dissolved solids (TDS), with values ranging from approximately 260 to 1,400 milligrams per liter (mg/l). Values for pH range from 7.0 to 8.0 indicating a neutral to basic character. Metals concentrations typically are low, with most constituents below detectable limits (Golder Associates Inc. 1995e).

Groundwater affected by historic mining operations within the Pinal Creek basin primarily is confined to the alluvial system and is characterized as low pH with high metals and TDS. Water quality in portions of the water-bearing sediments beneath Bloody Tanks Wash and Miami Wash, and Historic Webster Lake reflect impacts from historical mining activities. The nature and extent of impacts are the focus of an on-going investigation being performed by Cyprus Miami and other corporate members of the Pinal Creek Group for Aquifer Protection Permitting and the Arizona Water Quality Assurance Revolving Fund (WQARF) (Golder Associates Inc. 1995e).

Webster Lake was created in the 1940s when mine tailings dammed the flow of Webster Gulch and Lost Gulch near their confluence. The resulting impoundment was used for wastewater storage (Golder Associates Inc. 1995e and g). In the early 1980s, the Central Arizona Association of Governments (CAAG) Mineral Extraction Task Force (METF) indicated that water from Webster Lake could be moving through the ancestral alluvial channels of Webster and Lost Gulches and discharging to the alluvial aquifer of Miami Wash (CAAG 1981). Investigations showed a six-mile long plume of acidic heavy metal contamination of the aquifer below Pinal Creek. The Phase I Remedial Investigation of the Pinal Creek, Arizona, WQARF site has been completed, and extraction of contaminated groundwater has resulted in a 60- to 80 percent drop in contaminant concentrations in the Kaiser Basin area (ADEQ 1995).

Contaminated groundwater currently is being pumped from the aquifer and reused in mining operations. Historic Webster Lake is not part of the Pinal Creek WQARF program.

3.3.1.2 Study Area Groundwater Conditions

3.3.1.2.1 Study Area Groundwater Quantity

Study Area Groundwater Aquifers

The three types of groundwater aquifers present in the study area, which are the same as those in the region (see section 3.3.1.1.1), are described below. Discussion of these aquifers centers around their hydraulic conductivity. Hydraulic conductivity refers to the rate at which water can move through an aquifer. Water moves through the spaces between rock particles and this movement is typically very slow. The rate of movement of water is important to know because it allows prediction of how fast pollutants can move through an aquifer.

- Igneous/Metamorphic Unit. This unit includes the metamorphic and igneous rocks (Pinal schist, Schultze granite, Willow Springs granodiorite, Lost Gulch quartz monzonite, aplite dikes, and diabase). Water within this rock unit moves through fractures and the hydraulic behavior of the rock mass is governed by the density, spacing, length, and width of the fractures. The degree to which the fractures are interconnected also controls the occurrence and movement of water in these rocks. Hydraulic conductivity values for rocks within this unit range from 6.2×10^{-7} to 4.5×10^{-4} centimeters per second (cm/s). Wells in this rock unit usually yield less than 20 gpm; however, some localized zones of intense fracturing or weathering may produce larger quantities (Golder Associates Inc. 1995e).

- Volcanic Unit. The dacite is the only rock type within the volcanic unit present in the study area. Based on site investigations conducted by Golder Associates Inc. (1995e), the flow of groundwater in the volcanic unit appears to be largely controlled by rock discontinuities, such as fractures. The dacite has a fairly low hydraulic conductivity of 2.7×10^{-6} to 4.5×10^{-4} cm/s) and acts as a confining layer overlying the Whitetail conglomerate in the vicinity of Webster Gulch.

- Sedimentary & Recent Alluvial Unit. This unit contains the major water-bearing geologic formations within the region and the study area. The Gila conglomerate occurs within the west central and eastern portions of the study area, while the recent alluvial deposits are limited primarily to localized areas along the drainages. The Gila conglomerate consists of interbedded layers of silt- to cobble-sized material and typically contains a significant amount of clay. Some portions of the Gila conglomerate are comprised of well- graded sand, gravel, and cobbles in a matrix of clay and silt. Hydraulic conductivity values range from approximately 2×10^{-7} to 4.5×10^{-4} cm/s (Golder Associates Inc. 1995c).

Recent alluvial deposits of limited thickness occur along major drainages within the study area, including Webster Gulch and Little Pinto Canyon near the proposed BL leach site, and Lost Gulch near the proposed GMC leach facility. The alluvium varies from clayey sand and gravel to gravel and cobbles with some coarse sand and trace amounts of silt and clay. Hydraulic conductivity values range from 5.3×10^{-5} to 7×10^{-3} cm/s. The recent alluvium is partially saturated with the water table fluctuating in response to precipitation. Adjacent to the study area, alluvial deposits occur within portions of Bloody Tanks Wash. The thickness of alluvium is not consistent throughout the upper reaches of Bloody Tanks Wash and is absent in some areas. For example, adjacent to the Lower Oxhide pit, the alluvium occurs as a thin veneer overlying the Schultze granite and no groundwater is present. Farther downstream toward Miami, Arizona, the alluvium becomes thicker and saturated conditions exist (Golder Associates Inc. 1995c).

Study Area Groundwater Occurrence & Flow

Groundwater occurrence and flow within the study area predominantly are controlled by the presence of faults and fractures, the variability in the degree of bedrock weathering, and current/past mining activities. The water table can be laterally discontinuous depending on the degree of near-surface fracturing (Golder Associates Inc. 1995e). Depths to the local water table are highly variable and range from less than 2 feet to over 450 feet below the ground surface (bgs). Groundwater elevations generally decrease (the depth to water increases) in the direction of the mine pits and ground water flows radially towards the pits. A generalized groundwater contour map of the study area is presented in **Figure 3-5**.

Current and historical mining activities have altered natural surface drainage patterns, groundwater depths, recharge-discharge relationships, and water quality within the study area. The most significant factors influencing the surface water and groundwater systems are the mine pits, dewatering operations, leach pads, waste rock dumps, retention ponds, diversion ditches, and other surface water control features (Golder Associates Inc. 1995e and g).

Five major pits exist within the study area: the TJ pit, BL pit, Bluebird South pit (southern extension of BL), Upper Oxhide pit, and Lower Oxhide pit (**Figure 3-5**). In the western portion of the study area, groundwater flow generally is from west to east toward the TJ, BL, and Lower Oxhide pits. These pits appear to act as hydraulic sinks, with groundwater moving toward the pits in a radial pattern.

The cone of depression around the TJ pit is an east-west trending depression approximately 4,800 feet long and 1,200 feet wide (**Figure 3-5**). The inferred groundwater level around the pit mirrors the topography and ranges from 50 to 150 feet bgs. The cone of depression around the BL and Bluebird South pits is a north-south trending depression approximately 7,800 feet long and from 1,200 to 3,600 feet wide. Inferred groundwater depths are from 100 to 150 feet bgs. There is no cone of depression around the Upper Oxhide pit as the pit has been allowed to fill with water. The cone of depression around the Lower Oxhide pit is inferred to be circular

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Figure 3-5

GENERALIZED GROUNDWATER CONTOUR MAP WITHIN STUDY AREA

GREYSTONE

and approximately 3,000 feet in diameter. The outer edge of this cone of depression has an inferred depth to groundwater of approximately 100 to 150 feet bgs (**Figure 3-5**).

Fifteen domestic wells are located within a 1-mile radius of the proposed facilities, nine of which are owned by Cyprus Miami. Five of the 15 domestic wells are privately-owned wells on lands not leased or owned by Cyprus Miami and one well is federally owned. There are two private wells and one federal well located in Section 3, T.1S., R.14E. which are used for irrigation or stock watering (Golder Associates Inc. 1995e). There are 48 dewatering wells located adjacent to the active pit walls. The dewatering wells currently are being used to enhance slope stability and minimize slope failures within the pits. The wells range in depth from 120 to 800 feet below the ground surface and have pumping rates varying from less than 1 gpm to more than 150 gpm (Golder Associates Inc. 1995e).

Groundwater/surface water interactions across the study area are limited primarily to isolated springs and seeps, the presence of stormwater retention structures, and flow that occurs in the drainages in response to storm events. Most springs and seeps in the study area flow for a short distance before the water evaporates or infiltrates into the ground. In instances where retention structures contain water, seepage can occur from the embankment and become surface water where alluvial cover is limited or absent. Local recharge typically occurs following storm events when flows occur in the site drainages.

3.3.1.2.2 Study Area Groundwater Quality

Cyprus Miami collects water quality samples from the dewatering well system to assess groundwater quality in the active mining area. The samples typically are analyzed for pH, TDS, calcium, sulfate, iron, and copper. Occasionally, samples also are analyzed for magnesium, chloride, and zinc. Values of pH within the mining disturbance area commonly range from 5.6 to 8.0. TDS values range from 360 to 4,324 mg/l and typically exceed the EPA secondary drinking water standard of 500 mg/l. Calcium concentrations range from 12.4 to 392 mg/l, sulfate concentrations range from 9.9 to 2,572 mg/l, and copper concentrations range from 0.02 to 28.3 mg/l. Iron concentrations range from 0.06 to 267 mg/l and commonly exceed the EPA secondary drinking water standard of 0.3 mg/l (Golder Associates Inc. 1995e).

3.3.1.3 Project Area Groundwater Conditions

3.3.1.3.1 Project Area Groundwater Quantity

- <u>Oxhide Leach Facility.</u> The primary aquifer within the proposed disturbance area of the Oxhide facility is the igneous/metamorphic unit, which consists of the Schultze granite. Hydraulic conductivity values for this unit range from 6.2×10^{-7} to 6.5×10^{-5} cm/s. The occurrence and movement of groundwater within this unit primarily are influenced by fractures within the granite. The depth to groundwater measured in the monitor wells located in the downgradient lowland areas at the site during Golder Associates Inc.'s (1995e)

investigation varied from 7.5 to 28.5 feet below the ground surface. Groundwater flow typically follows the topography, moving from areas of higher elevation to lower elevation.

- BL Leach Facility. All three of the water-bearing rock units occur within the proposed disturbance area of the BL facility. Based on information collected by Golder Associates Inc. (1995e), the occurrence and movement of groundwater within the igneous/metamorphic aquifer (represented by diabase) and the volcanic (represented by the dacite) primarily are influenced by the number of and the interconnection of joints and fractures.

  The sedimentary and recent alluvial aquifer is represented at the site by the Gila conglomerate and recent alluvial deposits within washes. Groundwater within the Gila conglomerate principally occurs in a gravel zone near the contact between the Gila conglomerate and underlying dacite and is under confining pressure due to the relatively low permeability of the fine grained sediments found above this zone. The Gila conglomerate encountered in several of the boreholes (BLBR-4, BLBR-5 and BLBR-7) was fine-grained and contained little or no groundwater, except in zones directly adjacent to the contact with the underlying dacite or the overlying saturated alluvium (Golder Associates Inc. 1995e). The hydraulic conductivity of the Gila conglomerate at the BL Facility ranges from 2.0×10^{-7} to 4.5×10^{-4} cm/s.

  The depth to water in the wells at the proposed BL facility varied from 3.6 to 65.6 feet below the ground surface during the Golder Associates Inc. investigation (1995e), with the shallowest water levels present in the perched alluvial wells. The general direction of groundwater flow in the bedrock units is to the east-southeast, while the general direction of flow within the alluvium is to the east toward Bohme Reservoir. The gradient of the groundwater within the bedrock units is strongly influenced by the local topography (Golder Associates Inc. 1995e).

- GMC Leach Facility. The primary aquifers within the proposed disturbance area of the GMC facility are the igneous/metamorphic unit (represented by the Willow Springs granodiorite, diabase, and Lost Gulch monzonite) and the sedimentary and recent alluvial unit (represented by alluvium in the wash channels). Based on studies by Golder Associates Inc. (1995e), the occurrence and movement of water in the igneous/metamorphic unit primarily is influenced by the presence of fractures and dikes. Because of the typical association of dikes with zones of fracturing in the rock mass, groundwater was often encountered in these areas (Golder Associates Inc. 1995e). Hydraulic conductivity values for the Willow Springs granodiorite and Lost Gulch monzonite range from 6.8×10^{-7} to 4.5×10^{-4} cm/s.

  During the investigations performed by Golder Associates Inc. (1995e), the depth to groundwater along the downgradient lowlands at the proposed GMC facility varied from 2.4 feet to 37.7 feet below the ground surface. Groundwater elevations generally follow changes in the topographic elevations.

- Barney Waste Rock Site. The primary water-bearing units at the proposed Barney waste rock site are the igneous/metamorphic unit (represented by Pinal schist) and the sedimentary and recent alluvial unit (represented by Gila conglomerate and minor amounts of alluvium in the narrow drainage floors.

  The depth to groundwater at the site varies from less than 20 feet below the ground surface within the drainages to over 400 feet below the ground surface along the ridge tops. Groundwater movement generally is downgradient and toward the BL pit (Golder Associates Inc. 1995e).

3.3.1.3.2 Project Area Groundwater Quality

The baseline groundwater sampling program (Golder Associates Inc. 1995e) consisted of three rounds of monthly sample collection and testing. The testing focused on the areas within and surrounding the footprint disturbance areas of the proposed facilities and included nine wells at the BL site, three wells at the Oxhide site, nine wells at the GMC site, and one well at the Barney waste rock site (**Figure 3-6**). The test results are presented in the baseline report (Golder Associates Inc. 1995e) and summarized in the following paragraphs. The results represent naturally-occurring background values as they are upgradient from existing operations. Exceedances of water quality standards are also the result of naturally-occurring conditions.

- BL Facility. The pH values ranged from 6.2 to 7.3 and the TDS concentrations varied from 250 to 1,260 mg/l. The groundwater composition at the proposed BL facility ranged from a calcium bicarbonate to calcium bicarbonate/sulfate. Groundwater background samples obtained from most of the wells exceeded the recommended EPA secondary drinking water standard for TDS of 500 mg/l. Four constituents, aluminum, iron, sulfate, and manganese, were measured above EPA secondary standards. Groundwater samples from several wells exceeded the EPA primary drinking water standard and the State of Arizona Aquifer Water Quality Standard (AWQS) for gross alpha activity of 15 picocuries per liter (pCi/l). Groundwater samples from several wells also exceeded the EPA primary standards of 20 micrograms per liter (mg/l) for uranium and 4 millirems per year for gross beta.

- Oxhide Facility. The pH values ranged from 6.3 to 7.3 and the TDS concentrations varied from 250 to 500 mg/l. The EPA secondary standard for pH recommends that the pH of water be between 6.5 to 8.5. The groundwater composition type at the proposed Oxhide facility ranged from calcium bicarbonate to sodium bicarbonate. Aluminum and manganese were measured at concentrations above EPA secondary standards and gross alpha activity values exceeded both the EPA primary standard and the Arizona AWQS. Groundwater samples from these wells also exceeded the EPA primary standards for uranium and gross beta.

- GMC Facility. The pH values ranged from 6.4 to 7.3 and the TDS concentrations varied from 335 to 3,140 mg/l. The EPA secondary standard for pH recommends that the pH of

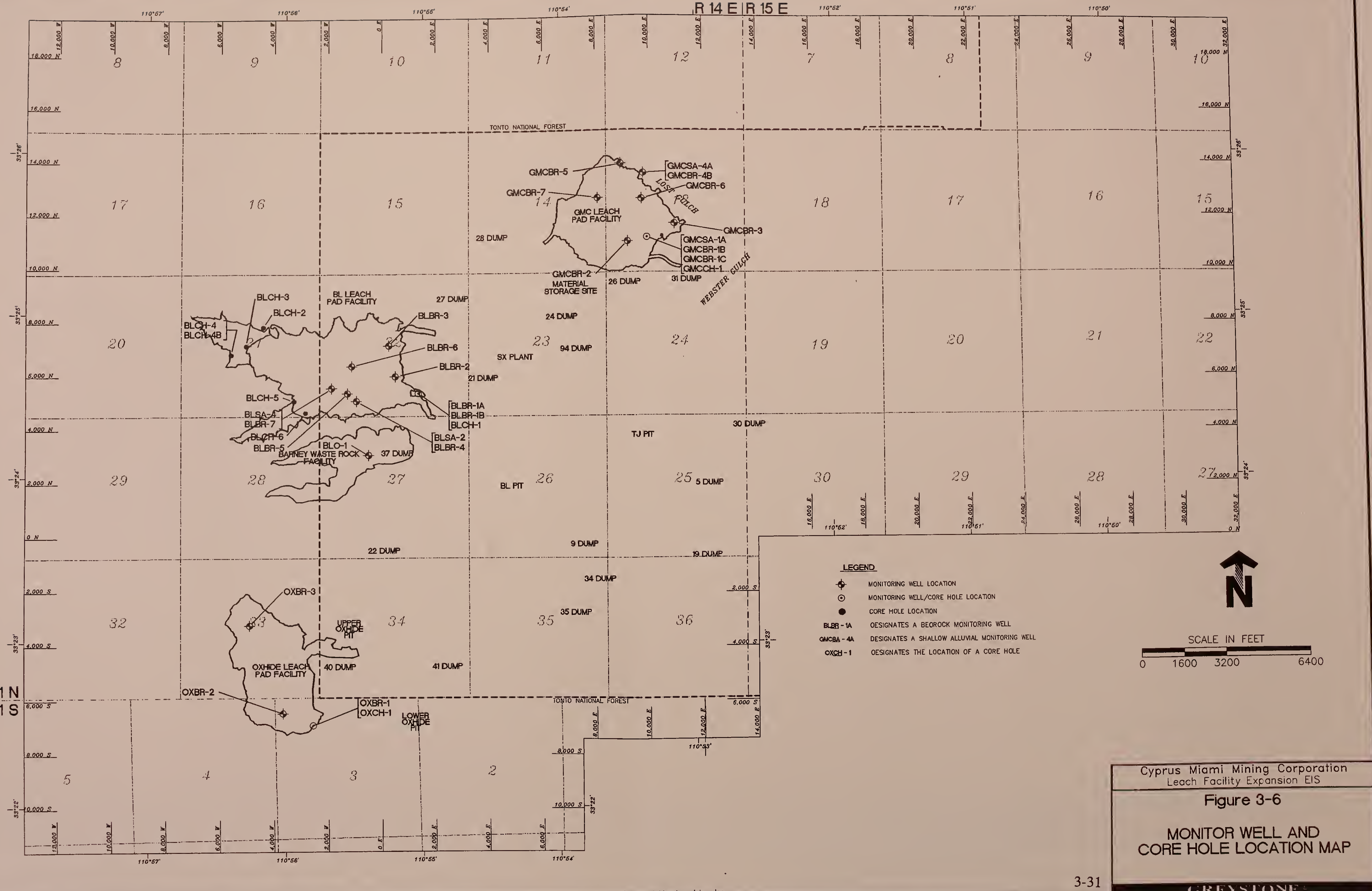

Figure 3-6

MONITOR WELL AND CORE HOLE LOCATION MAP

Source: Golder Associates, Inc.

water be between 6.5 to 8.5 and that the TDS concentration be below 500 mg/l. The EPA secondary standard for TDS was exceeded in all wells except one. Groundwater composition type at the proposed GMC facility ranged from calcium/sodium sulfate to sodium bicarbonate depending upon which geologic units the groundwater samples were obtained. Aluminum, sulfate, iron, chloride, and manganese were measured in concentrations above EPA secondary standards and chromium, cadmium and gross alpha activity exceeded both the EPA primary standards and Arizona AWQSs. Groundwater samples from these wells also exceeded the EPA primary standards for uranium and gross beta.

- Barney Waste Rock Facility. The pH ranged from 6.5 to 6.7 and the TDS values varied from 390 to 720 mg/l. The groundwater composition type is a calcium-bicarbonate. Aluminum, iron, TDS, and manganese were measured at concentrations exceeding EPA secondary standards. Groundwater samples from these wells also exceeded the EPA primary standard for gross beta.

3.3.1.3.3 Existing Wells

There are 15 registered domestic wells within a 1-mile radius of the proposed facility sites (Golder Associates Inc. 1995e). **Table 3-9** presents information about the wells and **Figure 3-7** illustrates their locations. These wells are among the 536 registered wells discussed in Section 3.3.1. Additional information on the wells is available in Appendix G of the Groundwater Baseline Report (Golder Associates Inc. 1995e).

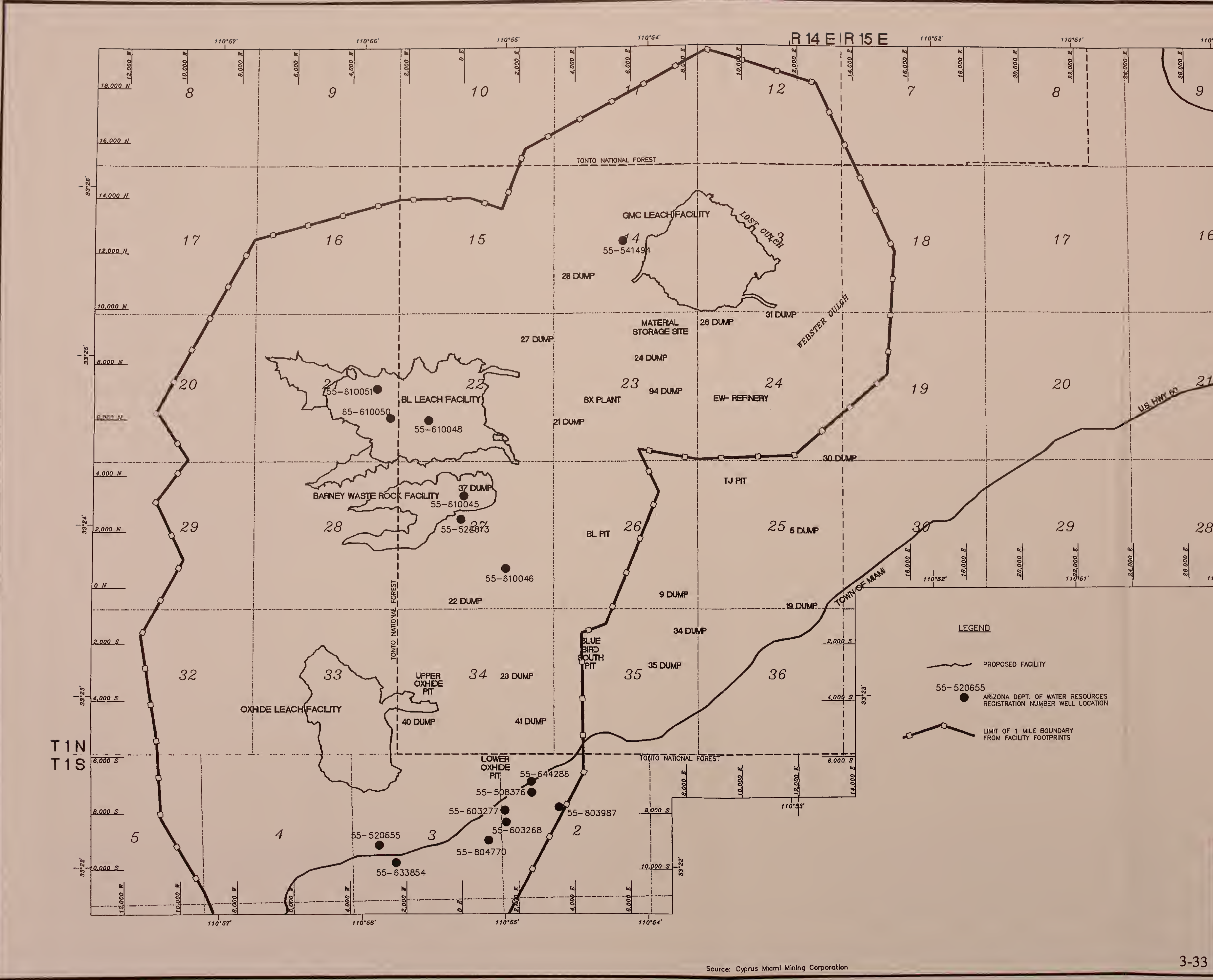

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Figure 3-7

DOMESTIC WELLS WITHIN A 1 MILE RADIUS OF PROPOSED FACILITIES

GREYSTONE

Table 3-9. Domestic Wells within a One-Mile Radius of Proposed Facilities

Well I.D.	Location	Owner	Water Use	Date Drilled	Depth to Water
55-541494	T 1 N., R 14 E., Sect. 14 NW NE NW	Cyprus Miami	Stock	Not Available	NA
55-610050	T 1 S., R 14 E., Sect. 21 NE SE SE	Cyprus Miami	Stock/Industrial	1982	80
55-610051	T 1 N., R 14 E., Sect. 21 NW NE SE	Cyprus Miami	Stock/Industrial	1973	NA
55-610048	T 1 N., R 14 E., Sect. 22 NW SW SW	Cyprus Miami	Stock/Industrial	1908	NA
55-610045	T 1 N., R 14 E., Sect. 27 SW SW NE	Cyprus Miami	Industrial	1920	82
55-610046	T 1 N., R 14 E., Sect. 27 NE SE NW	Cyprus Miami	Industrial	1939	27
55-522813	T 1 N., R 14 E., Sect. 27 SE SE NW	Cyprus Miami	None	1988	NA
55-644286	T 1 S., R 14 E., Sect. 2 NW SW NW	Cyprus Miami	None	1956	14
55-508376	T 1 S., R 14 E., Sect. 2 NW SW NW	Cyprus Miami	Stock	1983	85
55-603268	T 1 S., R 14 E., Sect. 2 SW SW NW	Private	Stock	1950	30
55-603277	T 1 S., R 14 E., Sect. 2 SW SW NW	Private	Stock	1964	30
55-803987	T 1 S., R 14 E., Sect. 2 SE NW	Private	Stock	1978	NA
55-633854	T 1 S., R 14 E., Sect. 3 SW NE SW	Private	Irrigation	Not Available	NA
55-520655	T 1 S., R 14 E., Sect. 3 NE NW SW	Private	None	1988	195
55-804770	T 1 S., R 14 E., Sect. 3 NE SE	Federal	Stock	1974	340

Source: Golder Associates Inc. 1995e.

3.3.2 Surface Water

3.3.2.1 Regional Surface Water

3.3.2.1.1 Regional Surface Water Quantity

<u>Regional Drainage Basin Topography & General Characteristics</u>

The Cyprus Miami mine lies within the watershed of Pinal Creek, which is located approximately 4 miles east of Miami and which flows north-northwest as part of the Upper Salt River watershed. The Pinal Creek drainage basin has an area of 195 square miles and elevations range from 7870 feet in mountains at the southern boundary of the basin to 2740 feet at Inspiration Dam at the north end of the basin (Eychaner, 1991). Pinal Creek enters the Salt River about 3 miles upstream of the high-water line of Roosevelt Lake (Lind and Hem, 1993). Roosevelt Lake, the largest of a chain of reservoirs that provide water for the Phoenix area, lies approximately 20 miles northwest of Miami.

Pinal Creek is generally intermittent until it reaches a point approximately 9 miles north of the Miami area, where it becomes perennial. The location where it becomes perennial varies in response to recharge during the previous few years (Faires and Eychaner, 1991). Smaller streams appear to be oriented along almost every bearing; however, the larger drainages generally have a west-east trend toward Pinal Creek. One exception is in the vicinity of Miami where a succession of northwest-southeast trending narrow canyons enter Bloody Tanks Wash. Bloody Tanks Wash flows from southwest to northeast through the towns of Miami and Claypool and joins the north-flowing Miami Wash, an intermittent tributary to Pinal Creek (**Figure 3-8**).

Regional Stream Flow

Stream discharge and water quality have been measured since 1979 at Inspiration Dam on Pinal Creek, about 10 miles downstream from the confluence of Miami Wash. The dam is a cast-concrete structure about 10 feet tall and 75 feet long that was built in 1912 and abandoned prior to 1929. The dam currently is filled with sediment. Base flow at this location ranges from approximately 2 to 14 cubic feet per second (cfs).

Stream flow typically is ephemeral in the numerous gullies, canyons, and washes that characterize this region (Eychaner and Stollenwerk, 1987). These streams often have significant flows, ranging from several cfs to more than 2,000 cfs, depending on the magnitude of the precipitation event and the size of the drainage area. The flows typically are of short duration. These brief but intense streamflows often carry significant amounts of soil and debris, which eventually are deposited on stream channel bends, around vegetation and other channel obstructions, and also in ponds and impoundments. (The 100-year, 24-hour storm event is 5.5 inches of rain).

Although seeps and springs can be found throughout the region, most are not perennial and flow only during the wetter months.

Regional Surface Water Use

At times, some of the surface water in the Pinal Creek watershed is diverted from the perennial portion of Pinal Creek and piped away for use by the mining industry. Surface water also is collected in impoundments by mining companies for use in various aspects of the mining process. Surface water in the watershed is not typically used for human consumption, although it often is used as a source of water for livestock.\

3.3.2.1.2 Regional Surface Water Quality

Surface water quality in the Pinal Creek watershed, specifically downstream of the Globe-Miami area, has been impacted by nearly a century of mining activities. Portions of Pinal Creek contain elevated levels of manganese, nickel, sulfate, and calcium, with lowered levels of dissolved oxygen that may relate to historical mining activities. Water samples from Pinal Creek

WATERSHED DESIGNATION	AREA (ACRES)
1	4512 *
1a	472
2 (TOTAL)	1687
2a	842
2b	434 *
2c	411
3	740
4	148
5	433
6	159
7	1499
8	202
9	323
10	823
11	302
12	438
13	703
14	194
15	429
16	1041
17	179

* INCLUDES AREA OUTSIDE STUDY AREA BOUNDARY

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Figure 3-8

EXISTING SURFACE WATER FEATURES WITHIN STUDY AREA

GREYSTONE

in 1990 contained 2,800 to 3,700 mg/l of dissolved solids, primarily calcium and sulfate, and had a pH of 5.8 to 6.8. Dissolved oxygen concentrations were less than 1 mg/l (Faires and Eychaner, 1991). The EPA secondary drinking water standard for TDS is $<$500 mg/l and for pH is between 6.5 and 8.5.

3.3.2.2 Study Area Surface Water

3.3.2.2.1 Study Area Surface Water Quantity

The study area topography and hydrology have been significantly affected by surface and underground mining activities. Open pit mining, leach pads, retention ponds, diversion ditches, and other surface water controls, such as pumping, exert notable local influences on surface drainage patterns. The surface water management plan at the mine incorporates practices that not only manage water needed for mine operation, but also reflect the fact that the mine is operated as a zero-discharge facility (no discharge allowed outside the facility boundaries). Surface water at the mine can be subdivided into three categories in order of increasing quality: 1) wastewater, stormwater runoff and aquifer remediation water; 2) industrial water; and 3) fresh water.

Large precipitation events, which result in significant amounts of infiltration through leach dumps and tailings, typically are managed by pumping down all receiving ponds in the time it takes for the water to completely infiltrate. Excess water also is managed to a large degree by evaporation, which averages more than 66 inches per year (Johnson 1993).

The potential uses for on-site surface water vary by category. An overall water balance (i.e., zero-discharge) is maintained at the mine by utilizing ponds, reservoirs, impoundments, and inactive mine pits for storage of excess water and by diversion and pumping of water to and from these areas depending on water requirements in other areas of the mining operation, such as ore wetting, leach dump operations, dust control, wash water, smelter operations, solvent extraction, and boilers.

Extensive controls are maintained to prevent surface water from entering historic Webster Lake. Webster Lake was created in the 1940s when mine tailings dammed the flows of Webster Gulch and Lost Gulch near their confluence. The resulting impoundment was used for wastewater storage. However, in the early 1980s the Mineral Extraction Task Force study indicated that infiltration from Webster Lake, following the ancestral alluvial channel of Webster/Lost Gulch, was discharging to the alluvial aquifer in Miami Wash. Therefore, in 1987 the EPA required the lake to be drained. By May 1988, draining of the lake was completed and most of the natural inflow to the Webster Lake area was cut off, being diverted around the lake, or impounded above the lake (Tolle and Arthur, 1991). There currently is no natural surface outflow from the Webster Lake area; any collected water is pumped away for use in the mining process or is placed on tailings piles to evaporate.

There are no perennial streams within the study area. Most of the study area is drained by six major ephemeral stream systems, which include Webster Gulch, Little Pinto Canyon, Lost Gulch, Barney Canyon, Needle Canyon and Needle Creek (**Figure 3-8**). A small area near the southern edge of the site is drained by Bloody Tanks Wash, also an ephemeral stream. Historically, these drainage systems were tributary to Miami Wash, which is in turn tributary to Pinal Creek, which flows into the Salt River a few miles upstream of Roosevelt Lake. The ephemeral streams, with the exception of the lower reaches of Webster Gulch and Bloody Tanks Wash, are all truncated by existing mine features and do not join Miami Wash.

For the baseline surface water study (Golder Associates Inc. 1995g), 17 primary drainage basins were identified (**Figure 3-8**). Of these primary basins, the Lost Gulch and Webster Gulch watersheds were subdivided for more detailed analysis. The total area of the watersheds studied is about 13,600 acres (21.3 square miles). Individual watersheds varied from about 150 acres to more than 4,500 acres. The natural drainage system has been modified by changes to the pre-existing topography and by the system of berms, channels, impoundments, and pumps utilized by the mine in its ongoing operations. Outflow from one watershed to another can occur by pumping or diversion (Golder Associates Inc. 1995g).

3.3.2.2.2 Study Area Surface Water Quality

Surface water occurrences across the study area are limited and fall into the following categories; 1) waste water, stormwater runoff, and aquifer remediation water; 2) industrial water; and 3) fresh water. Each category of water is dedicated to a different use. Because the mine is planned as a zero-discharge facility, no discharges of poor-quality surface water occur.

No sampling was conducted outside the project area as part of the baseline investigation and historic water quality data do not exist. An approximation of study area surface water quality can be obtained by extrapolating upgradient from the information presented in section 3.3.2.3.2, the discussion of project area water quality. Because the project area is essentially downgradient from the surrounding study area, project area surface water quality should be representative of study area water quality.

3.3.2.3 Project Area Surface Water

3.3.2.3.1 Project Area Surface Water Quantity

- Oxhide Leach Facility. The only surface water drainage identified by Golder Associates Inc. (1995g) within the proposed disturbance area for the Oxhide facility was the upper reach of Needle Creek (an ephemeral wash). There is no natural outflow from minor drainages at this site because Needle Creek and other drainages have been intersected by local surface water impoundments, pits, and other mine facilities. There are three impoundments on the site comprising 7.4 acres of open water.

- BL Leach Facility. Webster Gulch and Little Pinto Canyon occur within the proposed disturbance area for the BL leach facility, along with seven minor drainages. There is no natural outflow from any of the drainages at this site because Webster Gulch, below the confluence with Little Pinto Canyon, is interrupted by a surface water impoundment, the Barney North Pit, and the BL pit farther downstream (Golder Associates Inc. 1995g). There is an impoundment on site comprising 4.4 acres of open water.

- GMC Leach Facility. No major surface water drainages occur within the proposed disturbance area for the GMC facility. However, nine minor drainages were identified by Golder Associates Inc. (1995g). A small amount of surface water is captured and pumped from the GMC site by Cyprus Miami, while the remainder is routed around historic Webster Lake via diversion channels.

- Barney Waste Rock Site. Two major drainages, Barney Canyon and Needle Canyon, and two minor drainages occur within the proposed disturbance area for the Barney waste rock facility. No natural outflow from the drainages occurs since the drainages are interrupted by a sediment collection reservoir and, farther downstream, by the BL pit (Golder Associates Inc. 1995g).

In addition to the ephemeral stream systems identified above, surface water in the project area includes impoundments operated by Cyprus Miami and a small number of springs and seeps. Springs or seeps in the project area were identified during the surface water baseline study (Golder Associates Inc. 1995g). Flows from individual springs and seeps, which in most cases occur only in response to precipitation events, were estimated to be less than about 1 gpm, except for the Vigor of Life Spring, which had an estimated flow of 7.5 gpm.

There are no stream gaging records for the ephemeral streams within any of the project areas. Detailed hydrologic analysis was performed for the Webster Gulch drainage system, including Little Pinto Canyon. Estimated peak flows based on a 100-year, 24-hour storm event were 2,420 cfs for Webster Gulch above the confluence with Little Pinto Canyon, 1,400 cfs for Little Pinto Canyon above the confluence, and 4,560 cfs for Webster Gulch at the impoundment (Golder Associates Inc. 1995g). These flow rates represent a worst-case estimate of runoff from the 100-year, 24-hour storm event (5.5 inches).

Surface Water Occurrence and Flow

A description of the springs, seeps, and ponds at the proposed facilities is provided below.

- Oxhide Leach Facility. During the investigations by Golder Associates Inc. (1995g), surface water was limited to impounded stormwater runoff at the Oxhide site. Water was present in a surface water retention pond located in the upper portion of the proposed disturbance area. There is a minor seep (about 1 gpm) area at the toe of the retention structure. Two ponds, located adjacent to the existing 40 Dump, have formed in response to the accumula-

tion of water from upgradient runoff and leaching operations on the active 40 Dump. The amount of water present in these ponds varies throughout the year.

- BL Leach Facility. Twelve springs, seeps, or ponds were identified within or near the proposed BL facility by Golder Associates Inc. (1995g). The springs and seeps have been developed by excavation of short underground tunnels or are expressions of groundwater in areas where bedrock outcrops at the ground surface. Several springs at the BL site have been developed for water-supply purposes in the past, although the springs typically yield 1 gpm or less of water.

- GMC Leach Facility. Golder Associates Inc. (1995g) noted one spring at the proposed GMC facility. A small pond located upstream of Webster Lake but outside the area of disturbance is used for water management and contains water most of the time. The spring is ephemeral, as is a small stream that was flowing during the May/June surface water sampling event.

- Barney Waste Rock Site. Golder Associates Inc. (1995g) identified one small pond and one spring within the proposed Barney waste rock deposition site. A small ephemeral stream also was noted to be flowing in early May 1994, but only had standing water during the May/June sampling event and was dry in August 1994.

3.3.2.3.2 Project Area Surface Water Quality

No water quality sampling stations have been maintained within the project area by the U.S. Geological Survey or other governmental agencies. During the surface water baseline study (Golder Associates Inc. 1995g), samples were obtained from seeps, springs, and ponds and submitted to an environmental chemistry laboratory for testing. Some of the sites sampled during the first round (May/June 1994) were dry during the second round (August 1994). Golder Associates Inc. (1995g) reported that all of the ephemeral streams within the project area had insufficient flow for sampling, with almost all of them being totally dry. The results of field and laboratory testing are presented in the baseline surface water report by Golder Associates Inc. (1995g). A general characterization of the water quality sampling is presented in **Table 3-10**.

Table 3-10. Project Area Surface Water Quality Characterization

Parameter	Characterization
pH	Neutral to slightly alkaline (6.9 - 8.5 pH units)
Conductivity	Fresh to slightly brackish (230 - 3,200 μmhos/cm)
Water Composition	Calcium sulfate, sodium bicarbonate, calcium bicarbonate
Trace Elements in Detectable Amounts	Aluminum, arsenic, barium, cadmium, cobalt, iron, manganese, nickel, strontium, uranium, zinc
Exceedances of AWQS	Copper, cadmium

Source: Golder Associates Inc. 1995g.

3.3.2.4 Surface Water Rights

There are three water sources (or locations) on Cyprus Miami land, six water sources on BLM land and three on Forest Service land within the facility sites. Water rights are claimed by BLM, Cyprus Miami, and the Forest Service for a total of 22 filings on record with ADWR and claimed in the Gila River Adjudication. The filings are for stock watering, wildlife, domestic, or industrial uses from the springs and seeps, and for stock watering and wildlife uses from the earthen stock tanks. The BLM is the claimant for 8.2 acre feet of water from five sources and the Forest Service is the claimant for 0.1 acre feet from one source. Cyprus Miami has 16 filings on 11 sources for a total of 7,035.57 acre feet. **Table 3-11** summarizes the surface water filings and **Figure 3-9** shows the locations of the springs, seeps, and ponds in the study area.

The affected area is located within the Upper Salt River Watershed of the ongoing Gila River General Water Rights Stream Adjudication. The Arizona Department of Water Resources released a preliminary Hydrographic Survey Report for the Upper Salt River in December, 1992. However, to date, no water rights claimed have been adjudicated (e.g., the validity, relative priority dates, and ownership of these water rights have yet to be fully determined by the courts).

The multiple filings on Upper, Middle and Lower Webster Tanks, the Vigor of Life Spring, Frog Tank, and Little Pasture Tank underlie the BL leach facility. The Schultz Tank is mapped by the 1979 BLM Inventory along the perimeter of the Upper Oxhide Pit, but has not been seen in the mapped location. The Needle Creek filing also runs below the Oxhide leach facility. Sycamore Spring underlies the proposed Barney waste rock facility. Ralston Canyon Spring underlies the GMC leach facility.

Table 3-11. Surface Water Filings in CMMC Study Area

State File No.	Claimant	Description	Claim Date	Location				Use	Quantity AC FT	Landowner
				1/4 Section	Section	Township	Range			
36-69713	CMMC	Upper Webster Pasture Tank (BLPND-1)	1908	SWNW	22	T1N	R14E	S	1.07	BLM
38-69731	CMMC	Upper Webster Pasture Tank (BLPND-1)	1949	SWNW	22	T1N	R14E	S	0.5	BLM
33-74042	CMMC	Webster Gulch	<1919	SE	21	TIN	R14E	I	6318	BLM
38-17401	BLM	Upper Webster Pasture Tank (BLPND-1)	1949	SWNW	22	T1N	R14E	S/W	2.50	BLM
36-69715	CMMC	Lower Webster Pasture Tank	1908	NWSWSE	22	T1N	R14E	S	0.46	BLM
38-69735	CMMC	Lower Webster Pasture Tank	1949	NWSWSE	22	T1N	R14E	S	0.28	BLM
38-89073	BLM	Lower Webster Pasture Tank	1949	NWSWSE	22	T1N	R14E	S/W	0.20	BLM
36-69716	CMMC	Middle Webster Pasture Tank	1908	NESW	22	T1N	R14E	S	0.61	BLM
38-69737	CMMC	Middle Webster Pasture Tank	1949	NESW	22	T1N	R14E	S	0.30	BLM
38-17399	BLM	Middle Webster Pasture Tank	1949	NESW	22	T1N	R14E	S/W	0.6	BLM
38-17421	BLM	Schultz Tank	1967	SWNW	34	T1N	R14E	S/W	0.2	BLM
4A-4282 (CWR 2685)	CMMC	Vigor of Life Spring (BLSPR-5)	1957	NWSWSW	22	T1N	R14E	D/S	1.69	BLM
PWR 107 (BLM Fed. Reserved Right)	BLM	Vigor of Life Spring (BLSPR-5)	1926	NWSWSW	22	T1N	R14E	S/W	4.7	BLM
38-69729	CMMC	Little Pasture Tank (BLSPG-4)	1949	NESE	21	TIN	R14E	S	0.22	USFS
36-69706	CMMC	Little Pasture Tank (BLSPG-4)	1908	NESE	21	TIN	R14E	S	0.22	USFS
38-69727	CMMC	Frog Tank	1973	NWSE	21	TIN	R14E	S	0.5	USFS
36-69708	CMMC	Frog Tank	1908	NWSE	21	TIN	R14E	S	0.5	USFS

Table 3-11. Surface Water Filings in CMMC Study Area (Continued)

State File No.	Claimant	Description	Claim Date	Location				Use	Quantity AC FT	Landowner
				1/4 Section	Section	Township	Range			
38-83833	USFS	Unnamed Tank	Between 1967 & 1976	NWSE	21	T1N	R14E	S W	0.08 0.02	USFS
36-23654	CMMC	Needles Creek	<1919	N½SE¼ N½SW¼	33 34	TIN TIN	R14E R14E	I	711	CMMC
36-21237	CMMC	Sycamore Spring (BOSPG-1)	1908	NWSW	27	TIN	R14E	S	0.31	CMMC
4A-4277 (CWR 2681)	CMMC	Ralston Canyon Spring (GMCSPG-1)	1908	NESE	14	TIN	R14E	S	0.31	CMMC
4A-4281 (CWR 2684)	CMMC	Moonlight Spring (BLSPG-3)	1908	SESE	21	TIN	R14E	D S	0.6	USFS

Notes:
S =Stock watering
W =Wildlife
I =Industrial
D =Domestic

Source: Cyprus Miami Mining Corporation

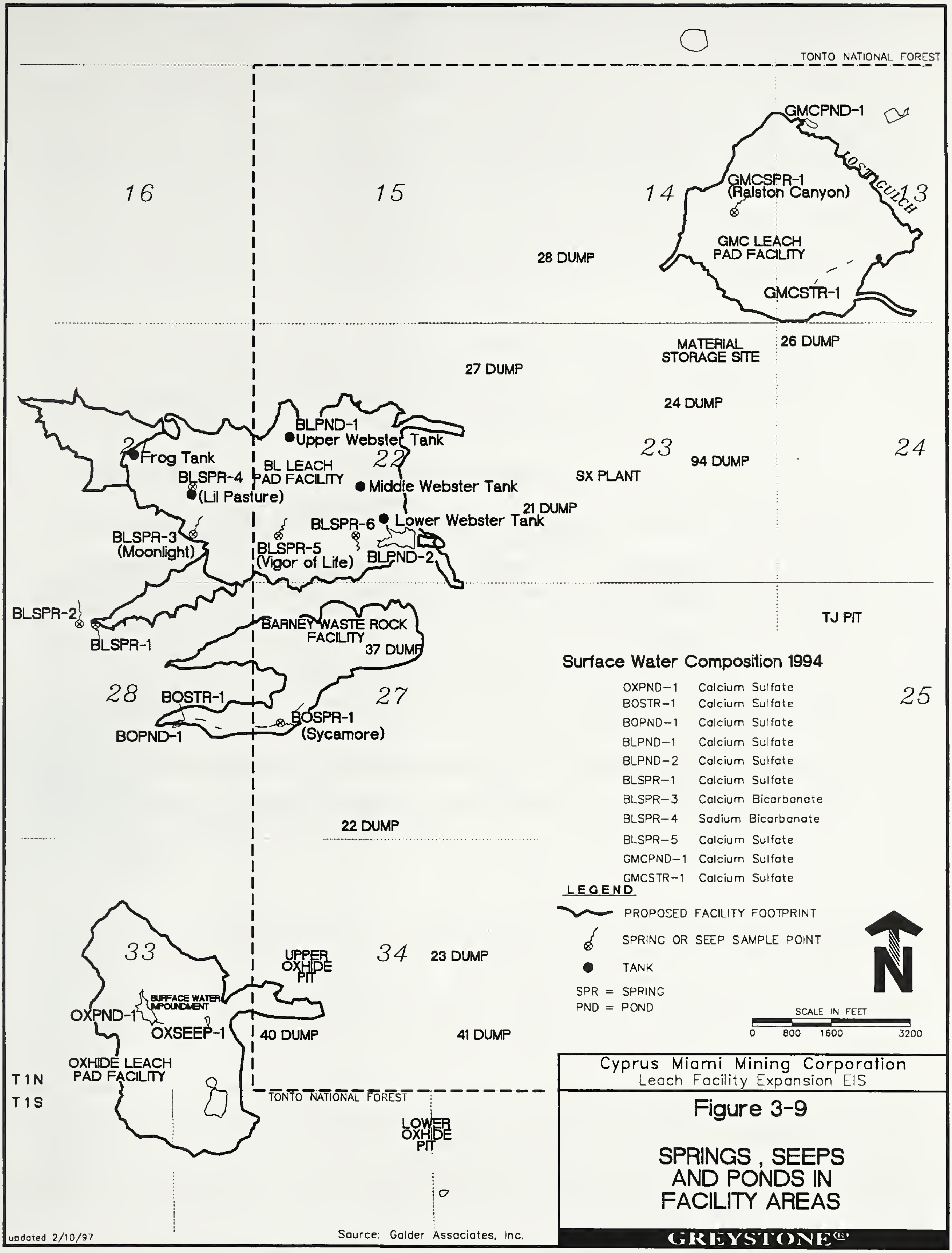

Figure 3-9

SPRINGS, SEEPS AND PONDS IN FACILITY AREAS

3.3.2.5 Waters of the United States

The U.S. Army Corps of Engineers (COE) regulates the discharge of dredged and/or fill material into waters of the United States, including adjacent wetlands. Field delineations of jurisdictional wetlands followed the protocols and data provided in the 1987 *Corps of Engineers Wetlands Delineation Manual* (Technical Report Y-87-1). Detailed results are presented in *Delineation of Potentially Jurisdictional Water of the United States at Four Proposed Expansion Sites Near Miami, Arizona: Cyprus Miami Mining Corporation Leach Facility Expansion (April 1995)* (Cyrpus Miami Mining Corporation 1995b).

The COE has determined that a total of 9.22 acres of waters of the United States is present within the overall proposed project area (**Table 3-12**). Drainages (washes) total 3.94 acres, surface impoundments total 5.22 acres, and wetlands total 0.06 acres (**Table 3-12**). **Figure 3-10** depicts the jurisdictional waters within the proposed project area.

Table 3-12. Summary of Jurisdictional Waters of the United States at Cyprus Miami near Miami, Arizona

Facility Site	Drainages	Surface Impoundments	Wetlands	Total (acres)
Oxhide	0.28	1.53	0.059	1.869
GMC	0.57	-	0.001	0.571
BL	2.73	3.69	-	6.42
Barney Waste Rock	0.36	-	-	0.36
TOTALS	3.94	5.22	0.06	9.22

Source: Cyprus Miami Mining Corporation 1995b.

3.4 SOILS

The study area is characterized by a dissected and variably broken topography developed in response to erosion across complex fault structures and diverse rock formations. Soils have formed on landforms dominated by gently- to steeply-sloping small mountains, ridges, eroded hills, colluvial slopes, and drainageway bottoms. A wide range of soil characteristics occurs in the study area due to the complexity of geologic materials, slope, aspect, elevation, and climatic factors.

Soil mapping and characterization was conducted in 1994 and 1995 for a study area encompassing the proposed project area and surrounding buffer zones (Golder Associates Inc. 1995h). Approximately 5,640 acres of the 12,300-acre soil survey area have been previously disturbed or heavily influenced by past or current mining activities and were not surveyed. The soil

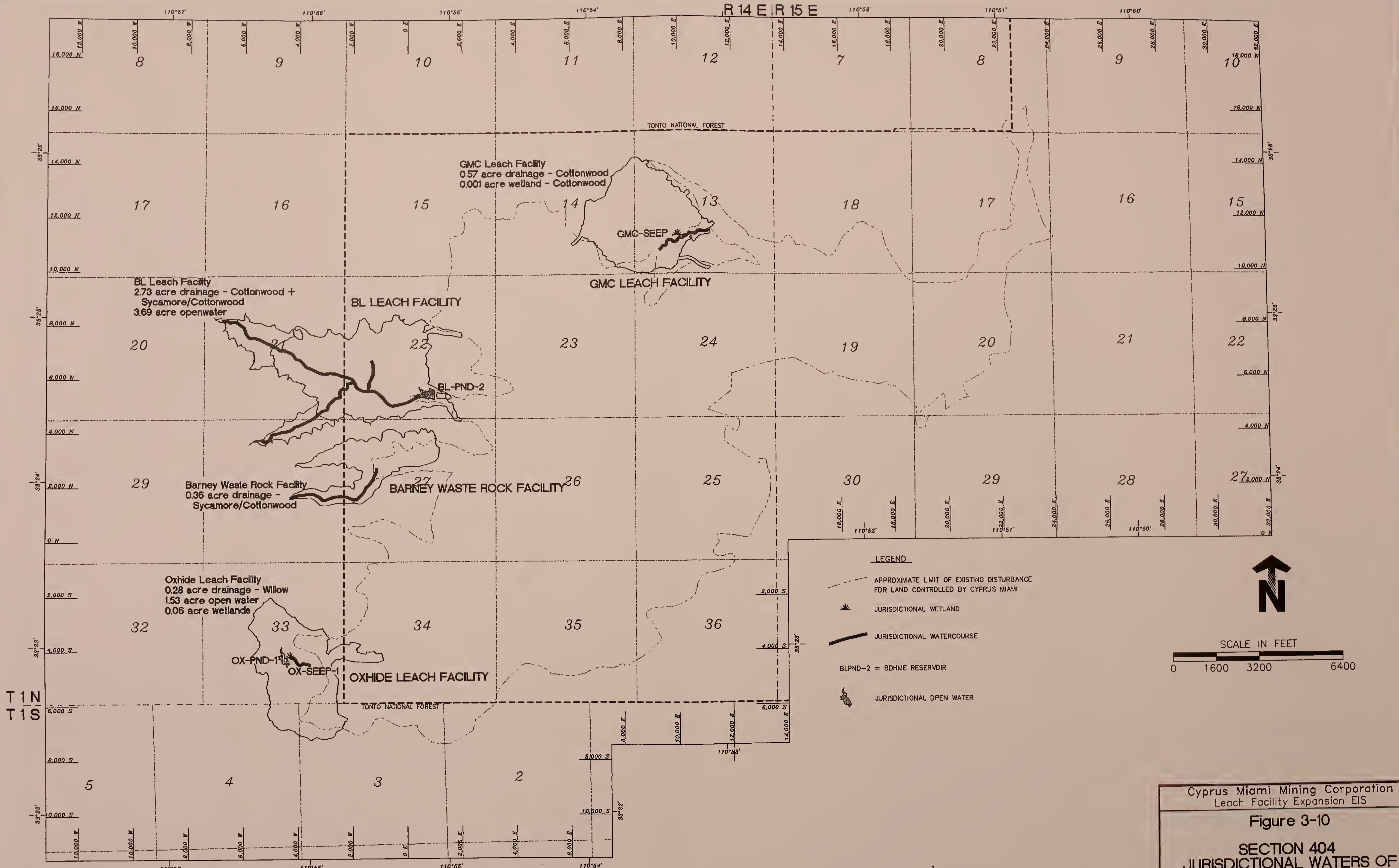

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Figure 3-10

SECTION 404 JURISDICTIONAL WATERS OF THE US (INCLUDING WETLANDS)

Source: Golder Associates, Inc.

GREYSTONE

survey primarily concentrated on the approximately 1,057 acres of new disturbance associated with the proposed action. No previous soil mapping in the general area had been conducted by the Natural Resources Conservation Service (formerly the Soil Conservation Service), the Forest Service, or the BLM. Fourteen major mapping units were described and mapped in the soil survey. The major characteristics of these units are summarized in **Table 3-13**, and include: map unit symbol and name, family classification, parent material/geologic substrate, topographic position, soil sample numbers, soil depth, texture, pH, rock fragment percent, typical vegetation, potential soil salvage depth, percent of unit salvageable, salvage limitations, and other pertinent comments. **Figure 3-11** shows the occurrence of the soil mapping units within the study area.

Potential soil salvage volumes available as growth medium (combination of soil and subsoil) to be used as a substrate for growing plants and plating material (coarse material with large fragments used to provide a stable surface) for erosion control are presented in **Table 3-14**. A total of 512,844 cubic yards from the upper soil horizon is estimated to be available as growth medium. Another 430,019 cubic yards from the lower horizon is estimated to be available as plating material. The results of the soil survey,in terms of the amount of a particular unit that is salvageable, may or may not correlate closely with what is actually retrievable in the field.

Soils on the proposed Oxhide leach facility site are mapped in two units—A1 and A2. Both map units are principally on Schultze granite in steep, dissected terrain. Elevations of these map units range from 3,800 to 5,050 ft-above msl. Slopes for map unit A1 range from 35 to 100 percent, but are predominantly 40 to 80 percent with some short vertical cliffs of rock outcrop. Vegetation is primarily oak chaparral with a large percentage of beargrass. Mountain mahogany is common on steep upper slopes. Soils in map unit A1 have very gravelly sandy loam textures and are shallow to very shallow over bedrock. Rock fragments and bedrock exposures cover between 50 and 80 percent of the ground surface. Soils in map unit A1 on the Oxhide site generally are not salvageable due to steep slopes, high percent of rock fragments, and rock outcrop. Small, widely-separated pockets of deeper soil exist, but are not practicable to salvage.

Map unit A2 is the equivalent of A1 on gentler sideslopes, saddles, and basins with slopes ranging from 5 to 35 percent. These soils have the same characteristics as those in A1 and also are not generally salvageable due to surface rubble, including boulders, rock outcrop, and coarse shallow soils.

The proposed Barney waste rock site is located on two soil map units—H and I. Soils in map unit H occur on ridges and slopes in the west-central portion of the study area on Gila conglomerate. Topography is characterized by an intricate dendritic pattern of weathered drainages. Slopes range from 25 to 60 percent at elevations of 4,000 to 4,800 ft-above msl. Unweathered conglomerate occurs as rock outcrops on ridges (Needle Peaks), along steeper slopes in upper Webster Gulch, and along scoured drainages. Vegetation is a mixture of juniper grasslands on south- and west-facing slopes, pinyon/juniper woodland on upper slopes, and oak chaparral on mid-level north-facing slopes. Soils in map unit H consist of a thin gravelly sandy

Table 3-13. Map Unit/Soil Characteristics

Soil Map Unit	Mapping Unit Name/Classification	Slope (%)	Parent Material/ Geologic Substrate	Topographic Position	Soil Sample Number*	Soil Depth (Inches)	Soil Texture	pH	Rock Fragments (%)	Potential Salvage Depth[1] (Inches)	% of Unit Salvage[2]	Salvage Limitations[3]	Typical Vegetation	Other Comments
A1	Lithic Ustorthents, loamy-skeletal - Rock Outcrop complex	35 - 100	Residuum, igneous (Schultze granite)	hills, ridges, slopes (steep dissected terrain)	01*, 02	0 - 10	very gravelly sandy loam	6.2	50 - 80	0	0	steep slopes, rock outcrop, surface rubble	oak chaparral, beargrass, mtn. mahogany	33 percent at Oxhide footprint in A1
A2	Lithic/Typic Ustorthents, loamy-skeletal - Rock Outcrop complex	5 - 35	Residuum, igneous (granite)	sideslopes, saddles, basins	03*	0 - 7 7 - 19	very gravelly sandy loam sand	6.5 6.2	35 - 65	0	0	surface rubble, rock outcrop, boulders	oak chaparral, beargrass, mtn. mahogany	27 percent of Oxhide facility area in A2
B	Typic Haplustalfs, fine, montmorillonitic	2 - 35	Mixed colluvium/ residuum	saddles, drainages	4/	0 - 48	gravelly sandy clay loam	4/	25 - 30	48	90	rock fragments	dense oak/manzanita	unit will not be disturbed
C	Typic Haplustalfs, loamy-skeletal, mixed	8 - 15	Mixed colluvium/ residuum	saddles, drainages, basins	4/	0 - 48	very gravelly sandy clay loam	4/	up to 60% or more in places	36	80	rock fragments	dense oak/manzanita	unit will not be disturbed
D	Typic Haplustalfs, fine, montmorillonitic	3 - 30	Mixed alluvium	drainages in Webster Gulch and Bloody Tanks Wash	BL7 BL8*	0 - 4 4 - 48	gravelly sandy clay gravelly sandy clay	6.2 7.3	20 - 40	30	70	high clay content, rock fragments	riparian	
E	Lithic Haplustalfs, loamy, mixed - Typic Haplustalfs, fine-loamy, mixed assoc.	5 - 60	Residuum (Pinal schist)	hills, ridges, slopes	W1	0 - 8 8 - 30	gravelly loam gravelly loam/ sandy loam	8.1 8.2	15 - 35	14	60	rock fragments	oak chaparral at higher elevations palo verde/cacti desert scrub at lower elevations	Northwest portion of GMC leach site
F1	Typic Haplustalfs, loamy-skeletal, mixed - Lithic Haplustalfs, loamy-skeletal, mixed - Rock Outcrop complex	35 - 65	Residuum/colluvium, mixed igneous substrates	hills, ridges, slopes	GMC1*, GMC2, BL5	0 - 3 3 - 12	extremely gravelly sandy loam extremely gravelly sandy loam	4.7 5.7	15 - 80	0	0	steep slopes, shallow soil, rock fragments	oak chaparral	66.9 percent of GMC facility area within F1 unit

Table 3-13. Map Unit/Soil Characteristics (Continued)

Soil Map Unit	Mapping Unit Name/Classification	Slope (%)	Parent Material/ Geologic Substrate	Topographic Position	Soil Sample Number*	Soil Depth (Inches)	Soil Texture	pH	Rock Fragments (%)	Potential Salvage Depth[1] (Inches)	% of Unit Salvage[2]	Salvage Limitations[3]	Typical Vegetation	Other Comments
F2	Typic Haplustalfs, loamy-skeletal, mixed - Lithic Haplustalfs, loamy-skeletal, mixed - Rock Outcrop complex	5 - 35	Residuum/colluvium, mixed igneous substrates	ridges, lower slopes, basins	GMC3*, GMC4	0 - 3 3 - 42	very gravelly sandy loam very gravelly sandy loam/ coarse sand	4.3 5.3	50 - 90	12	50	steep slopes	oak chaparral	10 percent of GMC facility area in F2 unit
G1	Lithic Ustorthents, loamy-skeletal, mixed - Rock Outcrop complex	35 - 75	Residuum/colluvium igneous (dacite)	hills, ridges, slopes	4/	0 - 20	very gravelly sandy loam	4/	35 - 60	0	0	rock fragments (boulders)	oak chaparral, oak woodland	24 percent of BL facility area in G1 unit
G2	Lithic/Typic Ustorthents, loamy-skeletal, mixed - Rock Outcrop complex	5 - 35	Residuum/colluvium igneous (dacite)	lower slopes, saddles, basins	BL3, BL4*, BL9	0 - 12	very cobbly sandy loam to sandy clay	5.6	15 - 60	12	50	rock fragments (cobbles, boulders)	oak chaparral	25 percent of BL facility area in G2 unit
G3	Lithic Ustorthents, loamy-skeletal, mixed - Rock Outcrop complex	5 - 60	Residuum/colluvium igneous (dacite)	hills, ridges, slopes	4/	0 - 20	very cobbly sandy loam	4/	15 - 60	0	0	steep slopes, shallow soil	oak woodland; oak/ash/mtn. mahogany on north slopes	
H	Lithic Haplustalfs, loamy, mixed - Typic Haplustalfs, fine, montmorillonitic - Rock Outcrop complex	25 - 60	Residuum/alluvium (old), Gila conglomerate	ridges, slopes	W2	0 - 8 8 - 40	gravelly sand loam over gravelly sandy clay loam	6.0 5.9	15 - 35	0	0	steep slopes, shallow soil	juniper grassland on S and W slopes, pinyon/juniper on upper slopes and oak chaparral on N slopes	SW slopes of BL facility area and 59 percent of Barney overburden site in H unit
I	Typic Haplustalfs, fine, montmorillonitic - Rock Outcrop complex	5 - 40	Residuum/alluvium (old), Gila conglomerate	toe slopes, drainages	BL1, BL2*, BL6	0 - 7 7 - 14 14 - 23	gravelly sandy loam gravelly sandy clay loam gravelly sandy clay	7.1 5.9 7.3	15 - 35	18	40	rock fragments and large boulders	4	17 percent of BL site in I unit

Table 3-13. Map Unit/Soil Characteristics (Continued)

Soil Map Unit	Mapping Unit Name/Classification	Slope (%)	Parent Material/ Geologic Substrate	Topographic Position	Soil Sample Number*	Soil Depth (Inches)	Soil Texture	pH	Rock Fragments (%)	Potential Salvage Depth[1] (Inches)	% of Unit Salvage[2]	Salvage Limitations[3]	Typical Vegetation	Other Comments
J	Aridic Haplustalfs, clayey-skeletal, montmorillonitic Calciorthidic Ustochrepts, coarse-loamy, mixed complex	15 - 60	Residuum/alluvium (old), Gila conglomerate	ridges, slopes	4/	0 - 40	gravelly sandy loam	4/	15 - 35	18	60		--	unit will not be disturbed

* Indicates the typical soil sample number/location from which information is taken for the next three columns (soil depth, texture, and pH). Rock fragment percent is an average range for the entire typical soil profile of the map unit.

1/ Potential salvage depth of growth medium (does not include plating material).

2/ Salvage. = Salvageable

3/ Limitations to salvage if the entire soil profile is unsalvageable. Limitations to deeper salvage if there is potentially salvageable soil in the map unit.

4/ Not sampled

Source: Golder Associates Inc. 1995h.

Table 3-14. Estimated Soil Salvage Availibility Within Proposed Distrubance Areas Cyprus Miami Expansion Project

Map Unit (Figure 3-11)	Growth Medium[1]				Plating[2]			
	Acres	Depth (in)	% of Map Unit	Volume (yd^3)	Acres	Additional Depth (in.)	% of Map Unit	Volume (yd^3)
E	58.7	30	70	165,786	58.7	30	40	94,735
F2	75.3	12	50	60,774	75.3	12	50	60,774
G2	119.0	12	50	95,993	119.0	12	30	57,596
E	149.4	18	40	144,610	149.4	54	20	216,914
E	40.5	14	60	45,681	40.5	0	0	0
Total	442.9			512,844	442.9			430,019

[1]For use as plant growth medium.
[2]For use as erosion control.

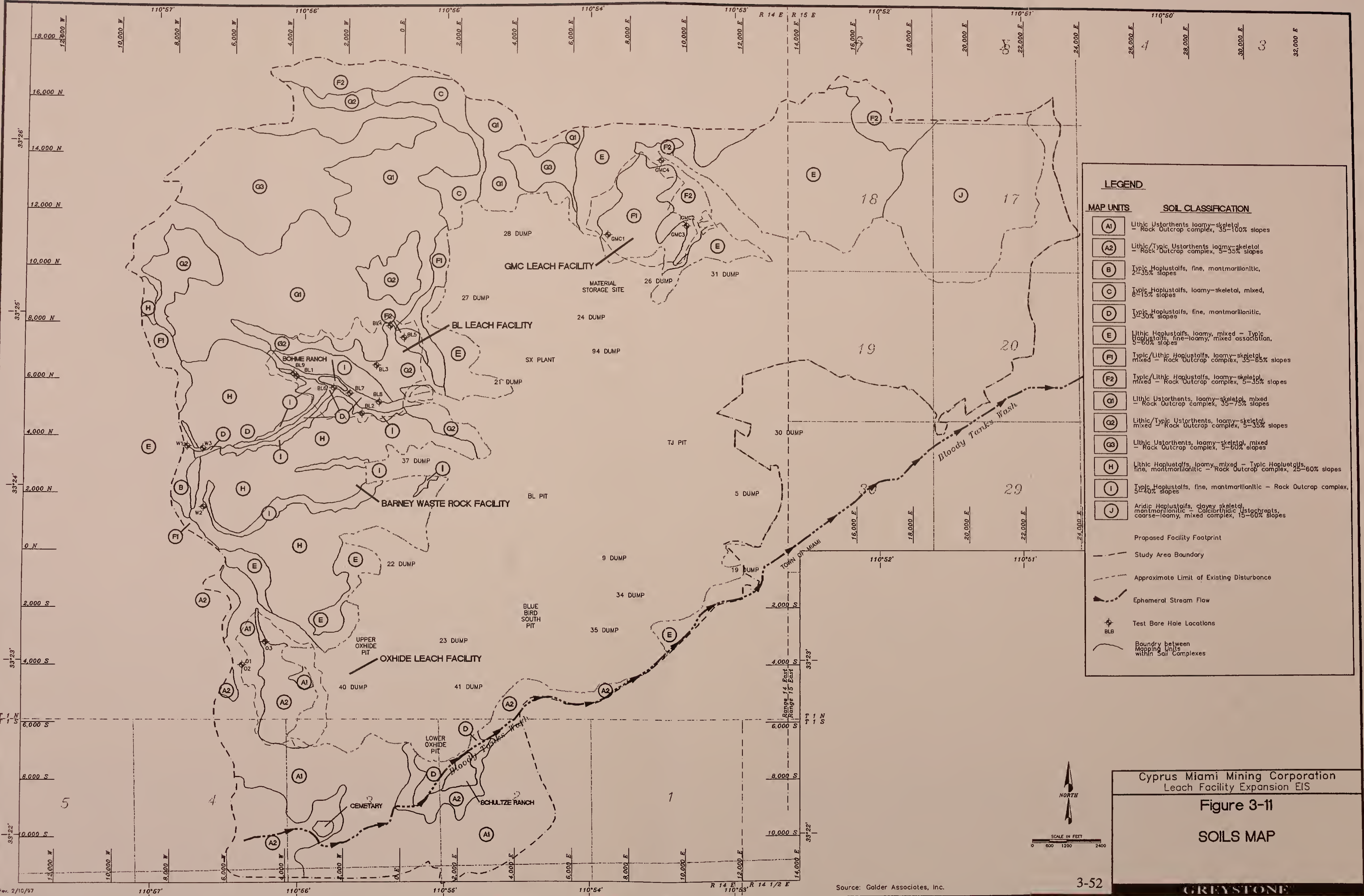

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Figure 3-11

SOILS MAP

loam surface over a sandy clay loam subsoil. Depth to bedrock ranges from 8 to 30 inches with a few small spots reaching 40 inches. Soils in map unit H are not salvageable due to steep slopes and predominantly shallow soil.

Soils of map unit I are developing on colluvial and mixed alluvial materials and may accumulate to depths of up to 8 to 10 feet on lower slopes and along drainages in areas of Gila conglomerate. Soils are salvageable in this unit, but only the top 18 inches of material is suitable as a growth medium. Deeper materials to 72 inches may be suitable for salvage for use in erosion control. Some of the drainages are scoured of material and some lower slopes have limitations to salvage due to steepness, discontinuous or shallow soils, and a large percent of rock fragments. It is estimated that about 40 percent of this unit may be salvageable as growth medium and 20 percent as plating material.

The proposed BL leach facility site is located on and adjacent to Webster Gulch north of the proposed Barney overburden site. Map units H and I are present on the BL site, as well as map units D, G1, G2, and a small portion of F1. Deep soils are present in map unit D in narrow drainages along Webster Gulch and a main tributary to the south. These soils are developing in mixed alluvial or colluvial materials at 4,000 to 4,200 ft-above msl, which contains numerous large colluvial boulders. Riparian vegetation is present with large trees and shrubs along the channels. These soils have gravelly sandy loam to sandy clay texture grading into undifferentiated mixed alluvium at 36 to 48 inches. Gravel fragments, subsurface cobbles, and large boulders account for 20 to 40 percent of the subsurface. These soils may be salvageable to variable depths depending on depositional patterns and presence of large boulders. Average depth of salvageable soil is about 30 inches over 70 percent of the unit, with deeper mixed alluvium locally salvageable to 60 inches over 40 percent of the map unit for use as erosion control plating material. Limitations to salvage are high clay content and cobble/boulder content.

Map units G1 and G2 occur over a large contiguous area in the northwestern portion of the study area at 4,000 to 5,450 ft-above msl almost exclusively on dacite. These units occupy the northern half of the BL site. Rock outcrops on ridges and slopes occur in map unit G1 and large surface boulders are common. Slopes for G1 range from 35 to 75 percent. Vegetation on G1 and G2 in the proposed BL facility area is oak chaparral. Soils in map unit G1 are gravelly sandy loams with 4 to 20 inches to bedrock and are not salvageable due to large surface boulders and a large percent of rock fragments in the soil profile.

Map unit G2 is the lower to mid-elevation equivalent of map unit G1 with slopes of 5 to 35 percent on saddles, lower slopes, and basins. Soils are generally deeper with a sandy loam to sandy clay texture over bedrock at 15 inches, with some areas of colluvium to 48 inches. Up to 60 percent cobbles are present in the subsurface. Soils may be salvaged to an average depth of 12 inches over 50 percent of map unit G2 and to 24 inches over 30 percent of the area for use as erosion control plating material. Limitations include surface boulders and high subsurface cobble content.

Soils in map unit F1 are on slopes of 35 to 65 percent on hills, ridges, and sideslopes. Vegetation is oak chaparral. Soils in this unit consist of a very gravelly sandy loam over mixed igneous, granitic, and limestone bedrock at 4 to 20 inches. This unit covers portions of the GMC site and the eastern edge of the BL site. Soils in this map unit are generally not salvageable. Limitations include steepness, shallow depth to bedrock, and high rock fragment content.

The proposed GMC leach facility site contains three soil map units—F1, F2, and E. Unit F2 is a lower slope equivalent of the previously described F1. Slopes are 5 to 35 percent at lower elevations of 3,500 to 4,200 ft-above msl in eroded and dissected basins and lower slopes. Some soils could be salvaged along the toeslopes of steep slopes in the lower eastern portion of the GMC site. Soil may be salvaged to 12 inches over 50 percent of the unit and to 24 inches over 50 percent of the area for use as erosion control plating material.

The northwest portion of the proposed GMC leach facility site is on map unit E. These soils are developing in residuum from Pinal schist. Slopes range from 5 to 60 percent. Soils are an association of types depending on slope and aspect. Soils on north- and east-facing slopes are deeper to bedrock with a fine-loamy family texture and those on the drier south-facing slopes are shallow over bedrock with a loamy family texture. Generally, soils in map unit E are a gravelly loam over bedrock at 5 to 30 inches. These soils are suitable for salvage to 12 to 16 inches over about 60 percent of the map unit. Limitations include depth to bedrock and rock fragments on the surface and in the profile.

3.5 BIOLOGICAL RESOURCES

3.5.1 Vegetation

3.5.1.1 Vegetation Types

A study area of approximately 8,034 acres was surveyed, resulting in the identification of ten vegetation communities in the area: (1) oak chaparral; (2) oak woodland; (3) pinyon/juniper woodland; (4) juniper scrub; (5) palo verde/cacti desert scrub; (6) Fremont cottonwood; (7) Fremont cottonwood/Goodding willow; (8) Goodding willow; (9) Arizona sycamore/Fremont cottonwood; and (10) tamarisk. The first five vegetation communities are collectively referred to as upland types while the latter five are riparian in nature. Upland and riparian vegetation types are briefly described in the following subsections. Further discussion of these vegetation types is provided in the Biological Baseline Report (Golder Associates Inc. 1995i). The acreage and percentage of the study area associated with each vegetation type are indicated in **Table 3-15**. The locations of individual vegetation types are shown in **Figure 3-12**. A species list compiled during the field investigation is presented in **Appendix B**.

Table 3-15. Estimated Coverage by Major Vegetation Community Types in the Study Area

Community Type	Acres in Study Area	Percent of Study Area
Oak chaparral	5,815	44
Oak woodland	565	4
Pinyon/juniper woodland	520	4
Juniper scrub	430	3
Palo verde/cacti desert scrub	630	5
Riparian[1]	74	1
Study Area Subtotal	8034	61
Disturbed[2]	5,156	39
Total	13,190	100

[1]Five riparian vegetation types are combined in this table but are discussed separately in the text.
[2]No distinction was made between disturbed area and bare ground. Most of the disturbed areas are devoid of vegetation or have small islands of native vegetation.
Source: Golder Associates Inc. 1995i.

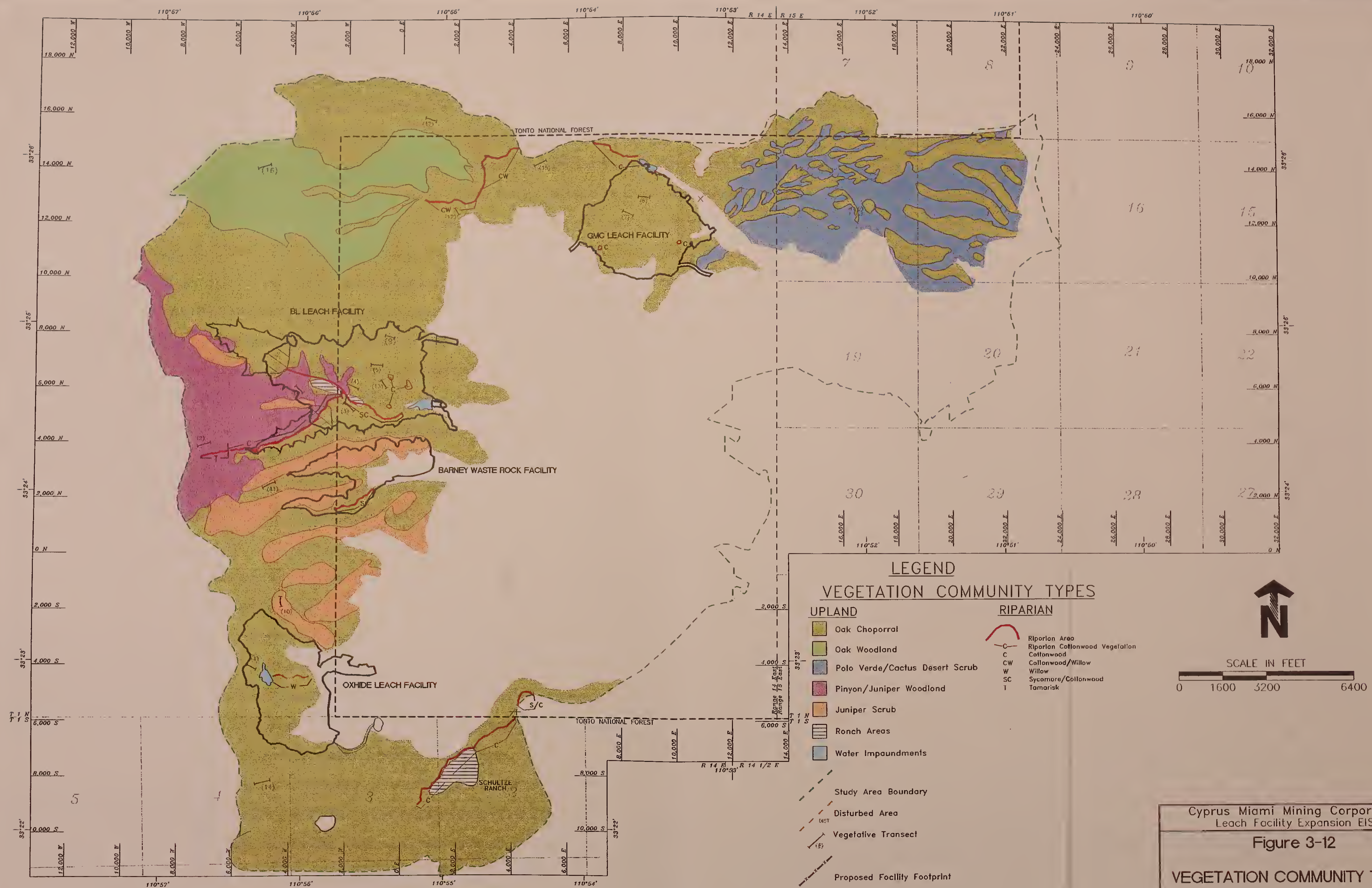
3.5.1.2 Upland Vegetation Community Types

Oak Chaparral

Oak chaparral is the most widespread and well developed community type in the study area. It occupies 5,815 acres or 44 percent of the study area (**Table 3-15**). It occurs at all elevations, and on most substrates, aspects, and slopes. It is considered the natural climax community across most of the study area on upland areas. The vegetation is dominated by scrub live oak (*Quercus turbinella*), but other shrubs, such as pointleaf manzanita (*Arctostaphylos pungens*), mountain mahogany (*Cercocarpus* sp.), desert deer brush (*Ceanothus greggii*), sotol (*Dasylirion wheeleri*), Lowell ash (*Fraxinus lowelli*), wait-a-minute bush (*Mimosa biuncifera*), beargrass (*Nolina microcarpa*), and skunkbrush sumac (*Rhus trilobata*), are common and locally abundant. The understory vegetation is sparse and appears to be repressed by livestock grazing in accessible areas (Golder Associates Inc. 1995i). General canopy cover for oak chaparral ranged from 41.7 to 97.9 percent. Shrub density ranged from 1,050 to 7,300 shrubs/hectare (Golder Associates Inc. 1995i). Occasional juniper, pinyon pine, and larger oaks occur sporadically among the oak chaparral community type.

Oak Woodland

The oak woodland community type occurs on the cool, moist toeslopes of ridges along Webster Gulch at about 4,400 ft-above msl and at elevations of 5,200 to 5,500 ft-above msl in the northwestern portion of the study area. This community type occurs on mostly dacite rock substrate associated with these two topographic positions. Oak woodland occupies 565 acres or 4 percent of the study area (**Table 3-15**). Emory oak (*Quercus emoryi*) is the dominant oak



Source: Golder Associates, Inc.

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Figure 3-12

VEGETATION COMMUNITY TYPES

GREYSTONE

woodland species with subdominant gray oak (*Quercus grisea*) and alligator juniper (*Juniperus deppeana*) as scattered associates. Canopy coverage averaged 62 percent with an average shrub density of 8,438 shrubs/acre (Golder Associates Inc. 1995i). At lower elevations, the oak woodland community type mixes with the oak chaparral type.

<u>Pinyon/Juniper Woodland</u>

The pinyon/juniper woodland community type occurs on hills and ridges in the vicinity and to the north of Needle Mountain and south and west of the Bohme Ranch. It occurs exclusively on the Gila conglomerate at 4,400 to 4,800 ft-above msl. It occupies 520 acres or 4 percent of the study area (**Table 3-15**). This community type has coahuila juniper (*Juniperus coahuilensis*) as the dominant tree with an occasional pinyon (*Pinus monophylla*) or mesquite (*Prosopis velutina*) associate. However, this entire community is dominated by shrubs common to the oak chaparral community type. Juniper density averaged approximately 575 trees/acre and pinyon density was about 200 trees/acre. Total vegetative cover for this community type was 62 to 69 percent. Average shrub density in this type was 3,875 to 9,375 shrubs/acre (Golder and Associates Inc. 1995i).

<u>Juniper Scrub</u>

This community type was described as a disturbed grassland type now dominated by shrubs with widely spaced junipers and an occasional pinyon or mesquite. The juniper scrub community type occurs on Gila conglomerate around Needle Mountain and the dry ridges immediately to the north at 4,300 to 4,700 ft-above msl. It occupies 430 acres or 3 percent of the study area (**Table 3-15**). Turpentine bush (*Aplopappus laricifolius*) and broom snakeweed (*Gutierrezia sarothrea*) dominate this type with occasional juniper trees and wait-a-minute bush shrubs present. The understory is dominated by sideoats grama (*Bouteloua curtipendula*) and red brome (*Bromus rubens*) with subdominant grasses including purple three-awn (*Aristida purpurea*), cane bluestem (*Andropogon barbinodis*), plains lovegrass (*Eragrostis intermedia*), and bull grass (*Muhlenbergia emersleyi*). Other associates include Wright's eriogonum (*Eriogonum wrightii*), desert thorn (*Lycium fremontii*), and banana yucca (*Yucca baccata*). The total average vegetative cover was 59 percent. Shrub densities averaged from 5,000 to 16,000 shrubs/acre (Golder Associates Inc. 1995i).

<u>Palo Verde/Cacti Desert Scrub</u>

The palo verde/cacti desert scrub community type occurs on south-facing slopes within the eastern portion of the study area between 3,400 and 3,800 ft-above msl on east-west running ridges. It occupies 630 acres or 5 percent of the study area, but does not occur in the proposed project area. White-thorn acacia (*Acacia constricta*), blue palo verde (*Cercidium floridum*), fairy duster (*Calliandra eriophylla*), and squaw bush (*Condalia spathulata*) dominate this community type with cacti species including cane cholla (*Opuntia spinosior*), prickly pear (*Opuntia phaeacantha*), and barrel cactus (*Ferocactus wislizeni*). A sparse understory is associated with

this type. Because this community type did not occur in the project area, it was not quantitatively sampled.

3.5.1.3 Riparian Vegetation Community Types

Five riparian communities were identified on or in the vicinity of the Cyprus Miami Expansion Project area. Except for portions of Lost Gulch and a few isolated springs, surface water flow in drainages that support riparian habitats is ephemeral. Along Lost Gulch, surface flows were intermittent during biological baseline field surveys. No perennial streams occur on the study area.

Fremont Cottonwood

The Fremont cottonwood community type occupies riparian zones in Little Pinto Canyon, Lost Gulch, and Bloody Tanks Wash. Fremont cottonwood (*Populus fremontii*) typically accounts for more than 75 percent of the total tree density and basal area for this community type (Szaro 1989 as cited in Golder Associates Inc. 1995i). Occasional understory species included seepwillow (*Baccharis glutinosa*), tamarisk (*Tamarix pentandra*), velvet ash (*Fraxinus velutina*), and Goodding willow (*Salix gooddingii*). Arizona sycamore (*Platanus wrightii*) occurs occasionally as an associate canopy species. The community occupies approximately 30 acres within the study area.

Fremont Cottonwood/Goodding Willow

Fremont cottonwood accounts for greater than 20 percent of the total tree density and greater than 50 percent of the total basal area for this community type. Goodding willow typically accounts for greater than 50 percent of the total tree density and greater than 20 percent of the total basal area in this community type (Szaro 1989 as cited in Golder Associates Inc. 1995i). Understory species associated with this community type included a well-developed understory of herbs and grasses, broadleaf cattail (*Typha latifolia*), and bulrush (*Scirpus* sp.). Arizona sycamore was also observed. This community type occupies 23 acres of the study area. Its occurrence is concentrated in upper Lost Gulch.

Goodding Willow

Goodding willow typically accounts for more than 70 percent of total tree density and total basal area in this community type (Szaro 1989 as cited in Golder Associates Inc. 1995i). Seepwillow were present as an associate species with yellow monkey flower (*Mimulus guttatus*), slender rush (*Juncus tenuis*), rabbitfoot grass (*Polypogon monspeliensis*), and chain fern (*Woodwardia fimbriata*) as common understory species. This community type occupied approximately 0.7 acres within the study area and was limited to the proposed Oxhide facility footprint.

Arizona Sycamore/Fremont Cottonwood

The two dominant species of this community type, Arizona sycamore and Fremont cottonwood, contributed more or less equally to the total tree density and basal area. Associated mid-story species included seepwillow, Arizona walnut (*Juglans major*), and velvet ash with wild petunia (*Petunia parviflora*) and clammy-weed (*Polanisia dodecandra*) in the understory. Mexican elder (*Sambucus mexicana*) occurred occasionally. The Arizona sycamore/Fremont cottonwood community occupied 18 acres within the study area, in the Barney overburden site, and the BL leach facility site.

Tamarisk

Tamarisk typically accounts for more than 75 percent of total tree density and total basal area in this riparian type (Szaro 1989 as cited in Golder Associates Inc. 1995i). Tamarisk generally occurred as a monoculture with uneven aged stands. However, desert broom (*Baccharis sarothroides*), burrobush (*Hymenoclea* sp.), and Freemont cottonwood seedling were observed interspersed with several patches of tamarisk. It occurred in Little Pinto Canyon and Lost Gulch, occupying only 2 acres in the study area.

Wetlands

Two jurisdictional wetlands were identified within the project area (**Figure 3-10**). These wetlands included Ox-Seep 1 associated with the proposed Oxhide leach facility and GMC-A.5-W associated with the proposed GMC leach facility. Ox-Seep 1 wetland covers approximately 0.059 acres and is dominated by various species of rushes (*Juncus* sp.) and bermudagrass (*Cynodon dactylon*) with sporadic Goodding willow along the riparian zone. GMC-A.5-W wetland covers approximately 0.001 acres and is dominated by emergent cattails (*Typha* sp.) with a few Fremont cottonwoods along the embankment edges. Total wetland acreage in the project area was 0.06 acres (SWCA, Inc. 1995a).

Open Water

Open water habitat (different than jurisdictional open water) included artificial, man-made surface water areas, such as stock ponds, and sediment traps. Approximately 11.8 acres of open water occur within the proposed facility sites, but none of it is natural. This acreage includes ponds and one reservoir.

3.5.1.4 Special Status Plant Species

This section and **Table 3-16** summarize the results of special status plant species surveys conducted by Golder Associates Inc. (1995i) in 1994, which focused on areas of potential impact by the Cyprus Miami Expansion Project.

Table 3-16. Special Status Plant Species Potentially Occurring in the Project Area

Common Name	Scientific Name	Status Federal/State
Arizona hedgehog cactus	*Echinocereus triglochidiatus*	E/HS
Arizona agave	*Agave arizonica*	E/HS
Hohokam agave	*Agave murpheyi*	S/HS
Tonto Basin agave	*Agave delamateri*	S/HS
San Carlos wild buckwheat	*Eriogonum capillare*	S/SR
Mogollon fleabane	*Erigeron anchana*	S/Unlisted
Varied fishhook cactus	*Mammillaria viridiflora*	Unlisted/SR

Federal Status:

E= Endangered; Taxa listed by the U.S. Fish and Wildlife Service as Endangered under the Endangered Species Act (ESA)
T= Threatened; Taxa listed by the U.S. Fish and Wildlife Service as Threatened under the ESA.
PE= Proposed Endangered; Taxa proposed for listing as Endangered under the ESA.
C= Candidate for listing as threatened or endangered.
S= Species considered sensitive by BLM or which are on the Regional Forester's List. These taxon include former Candidate Category 2 species.

State Status:

SE= State Endangered; State Endangered as listed on the Arizona Game and Fish Department's list of Threatened Native Wildlife (TNW) in Arizona. Species in imminent danger of extinction within Arizona.
SC= State Candidate; State Candidate is listed on the TNW list. Species with known or suspected threats, but for which substantial population declines from historical levels have not been documented.
HS= Highly Safeguarded; Native plants and parts of plants (e.g., seeds, fruit) whose survival is in jeopardy or danger of extinction.
SR= Salvage Restricted; Those not in HS category but subject to damage by theft or vandalism.

3.5.1.4.1 Endangered Plant Species

<u>Arizona Hedgehog Cactus</u> (*Echinocereus triglochidiatus var. arizonicus*)
(Federal Endangered, State Highly Safeguarded)

The Arizona hedgehog cactus is known to occur in central Arizona in Maricopa, Gila, and Pinal counties. This species generally occurs in narrow cracks between boulders in open slopes and in the understory of shrubs in the ecotone between Madrean Evergreen Woodland and Interior Chaparral (USFWS 1991 as cited in Golder Associates Inc. 1995i). It grows at elevations ranging from 3,700 to 5,200 ft-above msl. A known population occurs at Five Point Mountain, approximately two miles southwest of the study site (SWCA Inc. 1994 as cited in Golder Associates Inc. 1995i).

No Arizona hedgehog cacti were found during the 100-percent survey of the facility disturbance sites during late May and early June 1994.

Arizona Agave *(Agave arizonica)*
(Federal Endangered, State Highly Safeguarded)

Arizona agave is known to occur in the New River Mountains in Maricopa and Yavapai counties and the Sierra Ancha in Gila County (USFWS 1991 as cited in Golder Associates Inc. 1995i). It is found in the transition zone between oak/juniper woodland and mountain mahogany/oak scrub at an elevation of 3,000 to 6,000 ft-above msl on steep, rocky slopes, in drainage bottoms, or on relatively gentle slopes.

No Arizona agave individuals or populations were observed during the 100 percent field survey of the facility disturbance sites. Well-developed general community type association of the Arizona agave is absent from most of the study area. Suitable habitat for this species was only found in the northwest portion of the study area, outside the facility disturbance sites.

3.5.1.4.2 Other Sensitive Plant Species

The distribution and habitat requirements of the following sensitive plant species were reviewed in relation to the proposed leach pad expansion and their status is presented in **Table 3-16**.

- Hohokam agave
- Tonto Basin agave
- San Carlos wild buckwheat
- Mogollon fleabane

No special status plant species were observed during the plant surveys of the study area. It was determined that Hohokam agave and Tonto Basin agave have little potential for occurrence within the project area because elevations in the study area are well above their limits.

San Carlos wild buckwheat was not observed in the study area, but seeds of the species may be present in soils of disturbed sites. Reichenbacher et al. (1993) as cited in Golder Associates Inc. (1995i) notes that the "plant is an annual" and may exist primarily as a "seedbank" species, being present more commonly in the seed stage rather than as growing plants.

Some habitat features occur within the study area for the Mogollon fleabane, but it was determined that there is only a small potential for its occurrence within the study area. It was not found during special plant surveys.

3.5.2 Wildlife

3.5.2.1 Wildlife Habitat Types

Wildlife habitat types in the study area generally parallel the ten vegetation community types described in Section 3.4 since each of these community types is relatively homogeneous and unique with respect to wildlife habitat characteristics. Five of these community or habitat types are upland in nature and five are riparian. Aquatic habitats consisted of water impoundments created for mining operations, stock watering ponds, and ephemeral and intermittent springs and seeps.

3.5.2.2 General Wildlife Species

The discussion in this section is summarized from the biological baseline report (Golder Associates Inc. 1995i). The wildlife resource within the general study area is typical of the lower Sonoran and mid-upper Sonoran life zones. In general the wildlife resource is upland in nature. Although aquatic species exist, they are restricted to areas of suitable habitat. The following wildlife groups may be found within the general study area: big game species, furbearers, reptiles and amphibians, raptors, small mammals, passerine/songbirds (including the neotropical migrants), waterfowl, upland gamebirds, and fish.

3.5.2.2.1 Big Game

Mule Deer

Within southern and central Arizona, mule deer (*Odocoileus hemionus*) are most frequently associated with the chaparral and desert areas (Hoffmeister 1986). The chaparral areas provide browse both during the summer and winter. Dense stands of chaparral may be important for fawning and security cover.

Mule deer are known to occur infrequently throughout the study area, which included approximately 8,034 acres of suitable mule deer habitat. During the field surveys mule deer were most often associated with the oak chaparral oak woodland, pinyon/juniper woodland, and riparian woodland habitat types.

The study area is contained within and represents approximately 2.5 percent of Game Management Area 24B, which encompasses approximately 527,300 acres. Within this management area, the Arizona Game and Fish Department (AGFD) estimates a population of 2,700 mule deer. The AGFD estimates a low density of 1 to 5 deer per square mile throughout the study area, which is considered year-round range (Heslin 1995).

White-tailed Deer

Within Arizona, white-tailed deer (*Odocoileus virginianus)* are associated with oak-pinyon/juniper, ponderosa pine forests, desert scrub, deciduous forests, riparian habitats, and occasionally spruce-fir forests. However, the majority are found within the oak-pinyon/juniper community type. Also, where white-tailed and mule deer live in close proximity, white-tailed deer are generally found at higher elevations than mule deer (Hoffmeister 1986).

White-tailed deer were observed infrequently throughout the study area during the field surveys, and were most often associated with riparian, oak chaparral, oak woodland, and pinyon/juniper woodland habitat types. The entire study area of approximately 8,034 acres was considered suitable white-tailed dear habitat. The AGFD estimates 1,800 white-tailed deer inhabit within Management Area 24B (Heslin 1995). For the study area, AFGFD estimates a population density of 5 to 7 deer per square mile, except in the area of the Oxhide Leach Pad Site where a lower density of 1 to 5 deer per square mile is estimated (Heslin 1995). The study area is considered year-round range for white-tailed deer.

Javelina

Javelina (*Tayassu tajacu*) are typically associated with desert scrub, especially in thickets along creeks and old stream beds in Arizona. In addition, caves, mineshafts, or crevices in rocky slopes may be used as shelter. Javelina are typically found between 2,000 and 6,500 feet in elevation and rarely are found higher than the oak forests (Hoffmeister 1986).

Javelina occur throughout the study area, which included approximately 8,034 acres of suitable habitat. AGFD estimates a population of 1,400 javelina within Game Management Areas 24B, with densities ranging from 0.5 to 1.5 animals per square mile (Heslin 1995). These densities are considered low by the AGFD. The field surveys indicate that habitats utilized by javelina within the study area include mine adits, oak shrub/scrubland, oak woodlands, and riparian woodlands.

Mountain Lion

Mountain lions (*Felis concolor*) may be found within the chaparral and coniferous forest vegetation types in Arizona, especially near rock outcrops (Hoffmeister 1986). Mountain lions generally inhabit rugged areas where a stable population of deer exists. Approximately 6,765 acres of the study area were considered suitable habitat. Mountain lion sign was observed during field surveys within the area of Barney Canyon. The AGFD estimates a medium density lion population within Management Area 24B and the population appears to be stable (Heslin 1995).

Black Bear

The AGFD lists black bears (*Ursus americanus*) as potentially occurring within the study area. In Arizona, black bears are typically associated with higher elevational areas, however, during the early spring and summer they may move into areas containing manzanita berries (Hoffmeister 1986). These berries occur within the oak chaparral, oak woodland, and pinyon-juniper woodlands of the study area. The study area included approximately 6,900 acres of suitable bear habitat. Bear sign was observed near Pinto Creek and near the Bohme ranch during the field surveys. The AGFD estimates 55 bears inhabit Game Management Area 24B (Heslin 1995).

3.5.2.2.2 Furbearers

Coyotes (*Canis latrans*), grey fox (*Urocyon cinereoargenteus*), and skunks (*Mephitis* sp.) may occur in all habitat types within the study area. However, species such as raccoons (*Procyon lotor*) typically only occur within riparian or woodland habitat types. Sign or direct observation of all these species was noted during the field surveys.

Ringtails (*Bassaricus astutus*) may also occur within the study area. This species is most often associated with rocky areas, rock outcrops, and mine tunnels. Heavily wooded areas are not commonly used by ringtails. The ringtail is listed as a Forest Sensitive species. The AGFD indicates that ringtails have been observed near the study area; however, no ringtails were observed during the field surveys. The lack of observations may be related to their primarily nocturnal habits.

3.5.2.2.3 Reptiles and Amphibians

A wide variety of reptiles occurs within the study area and they may be found in all the habitat types. Species observed during the field surveys included the Arizona desert whiptail (*Cnemidophorus uniparens*), southwestern earless lizard (*Holbrookia texana scitula*), western collared lizard (*Crotaphytus collaris*), Clark's spiny lizard (*Sceloporus clarki*), southern plateau lizard (*Sceloporus undulatus tristichus*), tree lizard (*Urosaurus oinatus*), western diamondback rattlesnake (*Crotalus atrox*), black-tailed rattlesnake (*Crotalus molossus*), striped whipsnake (*Masticophis taeniatus*), Sonoran whipsnake (*Masticophis bilineatus*), western coral snake (*Micruroides euryxanthus*), and ground snake (*Sonora episcopa*).

Amphibians within the study area are typically associated with riparian and aquatic habitats. Amphibians observed during the field surveys included the red-spotted toad (*Bufo punctatus*), canyon tree frog (*Hyla arenicolor*), and lowland leopard frog (*Rana yavapaiensis*). The lowland leopard frog is a BLM and Forest Service sensitive species.

3.5.2.2.4 Raptors

Raptor species may occur within all habitat types of the study area. Raptor species observed during the field surveys included red-tailed hawk (*Buteo jamaicensis*), Cooper's hawk (*Accipiter cooperii*), American kestral (*Falco sparverius*), great-horned owl (*Bubo virginianus*), and turkey vultures (*Cathartes aura*). An active red-tailed hawk nest and an active Cooper's hawk nest were observed near the Bohme ranch during the field surveys. Other species expected to occur within the study area include Swainson's hawk (*Buteo albonotatus*), zone-tail hawk (*Buteo albonotatus*), common black hawk (*Buteogallus anthiacinus*), and golden eagles (*Aquila chrysaetus*).

3.5.2.2.5 Small Mammals

Small mammal species also occur within all habitat types of the study area. Species observed during the field surveys included desert cottontail rabbit (*Sylvilagus audubonii*), cliff chipmunk (*Eutamias dorsalis*), rock squirrel (*Spermophilus variegatus*), and porcupine (*Erethizon dorsatum*). Other species expected to occur within the area include deer mouse (*Peromyscus maniculatus*), kangaroo rat (*Dipodomys* sp.), silky pocket mouse (*Perognathus flavus*), and Harris' antelope squirrel (*Ammospermophilus harrissii*).

3.5.2.2.6 Songbirds, Waterfowl, and Upland Game Birds

The following songbirds are known to occur in the study area: Cassin's kingbird (*Tyrannus vociferans*), cliff swallow (*Hirundo pyrrhonota*), gray vireo (*Vireo vicinier*), Lucy's warbler (*Vermivoia luciae*), western kingbird (*Tyrannus verticalis*), and yellow warbler (*Dendroica petechia*). Species that were observed during field studies include northern mockingbird (*Mimus polyglottus*), black-throated sparrow (*Amphispiza bilineata*), dark-eyed junco (*Junco hyemalis*), phainopepla (*Phainopepla nitens*), cactus wren (*Campylorpynchus brunneicapilla*), American robin (*Turdus migratorious*), brown-headed cowbird (*Molothrus ater*), lesser goldfinch (*Carduelis psaltria*), and northern oriole (*Icterus galbula*). Although numerous species occur within the study area, their density and diversity vary by season. In addition, many are considered neotropical migrants because they spend a portion of the winter south of the United States.

Both waterfowl and upland gamebirds occur within the study area; however, species diversity is limited due to the lack of suitable habitat. Typical species in these two groups include mallards (*Anas platyrhynchos*), Gambel's quail (*Callipela gambelii*), and mourning doves (*Zenaida macroura*).

3.5.2.2.7 Fish

Two non-native fish species, bass (*Micropterus sp.*) and bluegill (*Lepomis macrochirus*), were observed during the 1994 field survey. They were seen in the surface impoundment in Webster Gulch at the east end of the proposed BL facility. Bluegill were also observed in a flooded adit adjacent to the impoundment.

The only native fish species known to occur in the study area is the longfin dace (*Agosia chrysogaster*). This fish is a BLM sensitive species. A 1994 field survey found longfin dace in a surface water impoundment in the proposed Oxhide facility area.

3.5.2.3 Management Indicator Species

In addition to general wildlife, the Forest Service has identified Management Indicator Species (MIS) within the Forest Service. MIS species are defined as those species whose presence in a certain location or situation at a given population level indicates a particular environmental condition. Their population changes are believed to indicate effects of management activities on a number of other species or water quality (USDA Forest Service 1985b). The MIS species for the Tonto National Forest are grouped according to vegetation types. **Table 3-17** shows the MIS species for each vegetation type and the approximate acreage of each vegetation type within the study area.

3.5.2.4 Threatened and Endangered Wildlife

The U.S. Fish and Wildlife Service (USFWS) has identified 24 threatened, endangered, proposed endangered, or sensitive wildlife species as potentially occurring within the study area (Spiller 1995). In addition, the Forest Service has identified 13 sensitive species that potentially occur within the Globe Ranger District and may occur within the study area (Pollock 1995). None of the threatened or endangered species has been observed in the study area. The following discussion is summarized from Golder Associates Inc. (1995j).

Table 3-17. Management Indicator Species on the Tonto National Forest

VEGETATION TYPE	SPECIES	ACRES OF AVAILABLE HABITAT
Pinyon-Juniper woodland	Ash-throated flycatcher (*Myiarchus cinerascens*) Gray vireo (*Vireo vicinior*) Townsend's solitaire (*Myadestes townsendi*) Plain titmouse (*Parus inornatus*) Common flicker (*Colaptes auratus*) Rufus-sided towhee (*Pipilo erythiophthalmus*)	520
Oak Chaparral	Rufus-sided towhee Black-chinned sparrow (*Spizella atrogularis*)	5,815
Desert scrub	Black-throated sparrow (*Aimophila bilineata deserticola*) Canyon towhee (*Pipilo fuscus*)	630
High-elevation riparian (above 3000 ft)	Hairy woodpecker (*Picoides villosus*) Arizona gray squirrel (*Scrurus arizonensis*) Warbling vireo (*Vireo gilvus*) Western woodpeewee (*Contopus sordidulus*) Common Black hawk (*Buteogallus anthracinus*)	74
Aquatic	Macroinvertebrates	<10

3.5.2.4.1 Endangered

Lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*)

This species forages in areas of saguaro, agave, ocotillo, paloverde, and prickly pear. Specific bat surveys were conducted in areas of suitable habitat within the proposed disturbance areas. A total of 90 mapped and unmapped man-made and natural features were surveyed according to protocols developed by Kingsley et al. (1991) and supplemented by an ultrasonic sound detector. No lesser long-nosed bats were observed within the study area.

No mine or natural features in the study area showed evidence of use by lesser long-nosed or other nectar-eating bats. There are no saguaros present in the study area, though there are numerous agaves. Because it is migratory, the lesser long-nosed bat occasionally may fly over the project area, which is 35 to 40 miles east of the published range of this species (Hoffmeister 1986).

Peregrine falcon (*Falco peregrinus anatum*)

Peregrines occupy a wide variety of habitats. They are typically associated with open country near rivers, marshes, and coasts. Cliffs are the preferred nesting substrate. However, tall man-made structures (i.e., high rise buildings and towers) may be used (Spahr et al. 1991).

The nearest known peregrine nest site (active in 1994) is located approximately 11 miles north-northwest of Globe in the Salt River Mountains. A pair of peregrines was observed in 1992 by Forest Service personnel approximately 7 miles south-southwest of Globe near Signal Peak (Golder Associates Inc. 1995i). No peregrine falcons or nest sites were observed during the field surveys. This lack of sightings may be due to the lack of suitable cliffs or rock outcrops for nesting. Although no peregrines were observed, they may occasionally fly over or forage in the study area. Foraging habitat potential for this species is low due to a lack of riparian/wetland areas that provide habitat for potential prey species and due to proximity to existing disturbed areas and ongoing operations.

Bald eagle (*Haliaeetus leucocephalus*)

Eagles feed on a variety of items, but primary prey consists of waterfowl, salmonids, suckers, and whitefish. Additionally, they will feed on carrion and small mammals (e.g., jackrabbits) under certain conditions (MBEWG 1986). Typically eagles are associated with large bodies of water such as major rivers and lakes.

In Arizona, bald eagles nest along the Salt, Verde, Gila, Bill Williams, and Agua Fria Rivers (AGFD 1988). Approximately 200 to 300 eagles may winter within Arizona, primarily in the White Mountains and along the Mogollon Rim (USFWS 1991).

No bald eagles were observed within the study area during the field surveys. In addition, bald eagles have not historically used this area for either nesting or winter habitat. However, eagles may forage throughout the entire study area. Foraging habitat potential for this species is low due to a lack of riparian/wetland habitats that provide habitat for potential prey species and due to proximity to existing disturbed area and ongoing operations.

Southwestern willow flycatcher (*Empidonax traillii extimus*)

The southwestern willow flycatcher breeds in riparian habitats along streams, rivers, or wetlands where dense stands of willow, medium-sized trees, and a cottonwood overstory are present. Riparian habitat must include areas containing thickets of willows, buttonbush, seepwillow, tamarisk, or other large shrubs and small trees. This habitat may include an overstory of cottonwood, boxelder, or other larger trees and dense vegetation from the ground to approximately 13 to 24 feet. Emergent vegetation may also be present. Potential riparian habitat must also contain surface water, boggy or swampy conditions, or saturated soils underlaying or adjacent to the stand during the midsummer breeding season (Tibbitts et al. 1994). No southwestern willow flycatchers were observed or detected in the study area during general field reconnaissance or during species-specific surveys of riparian habitats, using a willow flycatcher recording. Surveys in riparian habitats in the study area were conducted along Lost Gulch and in the vicinity of Prince Charming Spring. Though an *Empidonax* flycatcher was observed foraging in cottonwoods along Lost Gulch during one of the species-specific surveys, it was silent and field characteristics indicated that it was not a southwestern willow flycatcher. A subsequent species-specific survey in the same area also failed to detect the presence of southwestern willow flycatcher. In general, riparian habitats within the study area do not resemble riparian habitats known to be used by this species for nesting.

3.5.2.4.2 Proposed Endangered

Cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*)

Arizona is on the northern extreme of the cactus ferruginous pygmy-owl's range. Within Arizona, the pygmy-owl inhabits mesquite-cottonwood woodlands, which typically occur in riparian zones. However, they may also nest within natural cavities in both trees or saguaros. This species is typically found below elevations of 4,000 feet. However, since Arizona is on the northern extreme of the owl's range, it probably occurs well below this elevation (AGFD 1994). Few pygmy-owl populations are known within Arizona. Potential habitat for the cactus ferruginous pygmy-owl is comprised of Sonoran Desert Scrub with microphyll woodland species or columnar cacti large enough to provide cavities for nesting (Federal Register 59:237, p. 63975).

No cactus ferruginous pygmy-owls were observed during the field surveys. This lack of observations may be related to two factors: the study area is above the owl's historic elevational range; and the owl is very rare over its range. Due to the lack of vegetation suitable for providing nesting cavities, the project area does not contain suitable habitat for this species.

3.5.2.4.3 Additional Species of Concern

Additional species of concern include those designated by the BLM or Forest Service as sensitive species because their populations are thought to be declining within the state or Forest. These species have been identified as potentially occurring within the region containing the study area by both the USFWS and the Forest Service. **Table 3-18** lists these species, their habitats, and potential occurrence within the study area.

3.6 CULTURAL RESOURCES

3.6.1 Cultural Setting

3.6.1.1 Prehistoric Period

The history of Native American occupations in the Globe-Miami area began as early as five thousand years ago during the Archaic period, when people depended primarily on the hunting and gathering of wild food sources. Small groups moved seasonally to exploit resources in a variety of environmental zones. Associated archaeological sites represent temporary camps and the locations of hunting, gathering, and processing activities (SWCA, Inc. 1995b).

By the early centuries A.D., groups had begun to manufacture pottery. They became increasingly dependent on farming, although they continued to exploit wild resources. The first ceramic-period occupation of the area, at approximately A.D. 400, has been ascribed to early Hohokam peoples. Some researchers have argued for a Hohokam expansion from the homeland along the Salt and Gila rivers (Doyel 1976; Wood and McAllister 1980). The Hohokam manufactured red-on-buff pottery and occupied pithouses, structures partially excavated below the ground surface. Typical archaeological sites include pithouse villages, temporary camps, agricultural features, and locations where resources were obtained or processed.

Distinctive Hohokam characteristics disappeared from the Globe-Miami area at about A.D. 1100. The area is generally regarded as the heartland of the Salado, a culture that flourished in central Arizona area from A.D. 1150 to 1450. The Salado culture is distinguished by cobble masonry (pueblo) architecture, settlements surrounded by walls, and polychrome pottery. The most common types of early Salado sites were small pueblos of less than 50 rooms, "field houses" of one or two rooms, and a range of temporary sites. Later sites included these site types as well as large pueblos such as Besh-ba-gowa and Gila Pueblo, both located near Globe. The Salado apparently abandoned the Globe-Miami region after A.D. 1450 (SWCA, Inc. 1995b).

Table 3-18. Summary of the Potential for Occurrence and Determination of Effect for Forest Service and BLM Sensitive Species

Species	Habitats	Potential to Occur Within Study Area
Spotted bat (*Euderma maculatum*)	Poorly understood. Has been found in a variety of habitats including open ponderosa pine, desert scrub, pinyon-juniper, but primarily in river canyon sites. Known roosts are rock crevices high on steep cliff faces near water, where individuals roost alone (Navo et al 1992; Noel and Johnson 1993).	Occasionally may occur
California leaf-nosed bat (*Macrotus californicus*)	Primarily cave and mine dwellers in the Sonoran desert scrub, typically below 3,000 feet elevation. May remain active year-round if food and suitable roosts are present. They feed upon large night-flying beetles, grasshoppers, and moths, typically taking these species in flight (Hoffmeister 1986).	Occasionally may occur
Occult little brown bat (*Myotis lucifugus occultus*)	This species typically inhabits ponderosa pine and oak woodlands near water. However, they may utilize low desert areas along permanent watercourses (Hoffmeister 1986).	Occasionally may occur
Greater western mastiff-bat (*Eumops perotis californicus*)	Roost singly or in small groups in crevices and shallow caves on the sides of cliffs, and rock walls. Roosts have large openings below and may narrow above to a few inches. This allows the bats to drop several feet before beginning to fly. Roosts may be identified by urine staining (Hoffmeister 1986).	Occasionally may occur
Small-footed myotis (*Myotis cilioabrum*)	Roost in crevices and cavities of cliffs or rocks, or within caves or mine shafts. Specimens have been taken in a variety of situations, including over the hottest deserts among oaks, over chaparral, in riparian area with junipers and oaks, and the lower edge of the oak belt (Hoffmeister 1986).	Occasionally may occur
Allen's big-eared bat (*Idionycteris phyllotis*)	This species is most often associated with ponderosa pine, pinyon-juniper, Mexican woodland, white fir and Mohave desert scrub. Known roosts are in mine adits or caves (Noel and Johnson 1993).	Occasionally may occur
Pale townsend's big-eared bat (*Plecotus townsendii pallescens*)	Day roosts include caves or mine tunnels. Night roosts may include abandoned buildings. May be found from the desert scrub to desert mountains in oak-woodland, pinyon-juniper, or coniferous forests (Hoffmeister 1986).	May occur regularly
Big free-tailed bat (*Nyctinomopos macrotis*)	May be found in a variety of habitat types, including ponderosa pine, pinyon-juniper, Douglas-fir, and Sonoran desert scrub. These bats roost in rocky cliffs with crevices, and fissures and occasionally buildings (Hoffmeister 1986).	May occur regularly
Long-legged myotis (*Myotis volans*)	Most commonly found in ponderosa pine and coniferous forests. They are also found foraging in openings and near ponds within these habitat types (Hoffmeister 1986).	Occasionally may occur
Fringed myotis (*Myotis thysanodes*)	This species is found from low desert to ponderosa pine habitats, but appears to prefer oak woodlands. These bats may use buildings, caves and mine tunnels as night roosts. Known day roosts are inactive mine tunnels, caves and buildings. (Hoffmeister 1986, Noel and Johnson 1993).	May occur regularly
Yuma myotis (*Myotis yumanensis*)	Usually associated with open water, because it typically forages over water. These water areas may include large rivers, irrigation canals, and permanent ponds, streams and creeks. Roosts may include buildings, bridges, and natural crevices. It is not known to use mines or caves.	May occur regularly

Table 3-18. Summary of the Potential for Occurrence and Determination of Effect for Forest Service and BLM Sensitive Species

Species	Habitats	Potential to Occur Within Study Area
Cave myotis (*Myotis velifer*)	Roosts include mine shafts, tunnels, caves, and undersides of bridges. Known habitats include desert scrub with creosote brush, palo verde, brittlebrush, and cacti, and occasionally they are found in pine-oak vegetation (Hoffmeister 1986, Noel and Johnson 1993).	May occur regularly
Red bat (*Lasiurus borealis*)	This species is uncommon in Arizona. Mostly found over ponds, or along waterways among oaks, sycamores, and walnuts. This species may roost in the dense foliage of trees and shrubs (Hoffmeister 1986).	Unlikely to occur
Southern yellow bat (*Lasiurus ega*)	The southern yellow bat is typically restricted to the Washington fan palm (*Washingtonia* spp).	Unlikely to occur
Coati (*Nasua nasua*)	Coati inhabit woodlands in southeastern Arizona mountains where they are typically found near water (Hoffmeister 1986). The range of this species is restricted largely to Cochise, Santa Cruz, and eastern Pima counties, although stragglers have been recorded farther west and north (Hoffmeister 1986).	Unlikely to occur. The range of this species is restricted almost entirely to areas south of the study area.
Ring-tail (*Bassariscus astutus flavus*)	Ringtails occur throughout most of Arizona, with the exception of some of the nonmountainous, desert areas (Hoffmeister 1986). They inhabit rocky walls of canyons and peaks, caves, and lofts of buildings (Hoffmeister 1986).	May occur regularly
Western burrowing owl (*Athene cunicularia hypugea*)	An uncommon and rather local resident in Sonoran zone grasslands and fallow agricultural fields (Monson and Phillips 1981). A source of burrows is an important aspect of their habitat, and their distribution coincides with burrowing species such as ground squirrels and prairie dogs.	Unlikely to occur. Soils are generally rocky and no burrowing owls were observed during fieldwork.
Ferruginous hawk (*Buteo regalis*)	Uncommon to sparse and widely distributed resident of grassy plains of northern Arizona. Fairly common in winter in open country through southern Arizona, mainly in irrigated and grassy areas (Monson and Phillips 1981).	Occasionally may occur
Loggerhead shrike (*Lanitus ludovicianus*)	Loggerhead shrikes are more or less common summer residents throughout open habitats in the state (Monson and Phillips 1981).	Known to occur
American Bittern (*Botaurus lentiginosus*)	American bitterns are associated with fresh-water and brackish marshes, generally in tall vegetation (AOU 1983). There were no recent confirmed nesting records for Arizona listed by Monson and Phillips (1981).	Unlikely to occur
Common black-hawk	Summer resident along permanent streams, chiefly those in canyons, in southeastern and central Arizona (Monson and Phillips, 1981). The only breeding birds in Arizona south of the Gila River are in Aravaipa Canyon and in the Galiuro Mountains (Monson and Phillips, 1981).	Occasionally may occur
Harris' Hawk (*Parabuteo unicinctus*)	Local resident in Palo Verde-saguaro desert from north of Phoenix southeast of Tucson and southwest to Organ Pipe Cactus National Monument (Monson and Phillips 1981).	Extremely unlikely to occur
Green-backed heron (*Butosides striatus*)	Breeds uncommonly along streams and wooded ponds, particularly in areas with willows, south and west of the Mogollon Plateau (Monson and Phillips, 1981).	Occasionally may occur

Table 3-18. Summary of the Potential for Occurrence and Determination of Effect for Forest Service and BLM Sensitive Species

Species	Habitats	Potential to Occur Within Study Area
Belted kingfisher (*Ceryle alcyon*)	In Arizona, belted kingfishers occur primarily in winter along permanent fish-inhabited waters (Monson and Phillips 1981).	Occasionally may occur
Mississippi kite (*Ictinia mississippiensis*)	Local summer resident of cottonwood groves in the lower San Pedro valley (Monson and Phillips 1981). Scattered records during migration from Phoenix to upper San Pedro Valley (Monson and Phillips 1981).	Occasionally may occur
Black-crowned night heron (*Nycticorax nycticorax*)	Resident breeder in wetland areas in lower Colorado Valley and near Gila-Salt River confluence (Monson and Phillips 1981). Seen uncommonly elsewhere as a transient, sometimes in wooded areas without water, or as a winter visitor in southern and central Arizona (Monson and Phillips 1981).	Occasionally may occur
Osprey (*Pandion haliaetus carolinensis*)	Occur primarily along rivers and lakes where they forage for fish (AOU 1983). In Arizona, ospreys nest locally along streams below the Mogollon Rim. May occur anywhere on migration and have wintered along lower Colorado, Gila Valley, and Roosevelt Lake.	Occasionally may occur
Northern leopard frog (*Rana pipiens*)	In Arizona, occurs north of the Mogollon Rim (Clarkson and Roabaugh 1989).	Extremely unlikely to occur
Lowland leopard frog (*Rana yavapaiensis*)	Commonly found in permanent surface water habitats at lower elevations (mostly below 3,280 feet) in the western third and southern half of Arizona (Platz and Frost 1981).	Known to occur
Arizona toad (*Bufo macroscaphus*)	In Arizona, this species occurs from the Mogollon Rim southward (Sredle 1994). It is typically associated with riparian communities (Sullivan 1993), where preferred microhabitats are near relatively shallow permanent or intermittently flowing water over sandy or rock substrates (Price and Sullivan 1988). Irrigated cropland and reservoirs are also used.	Occasionally may occur
Mexican garter snake (*Thamnophis eques*)	May occur within the following habitat types: lowland river riparian woodlands, upland stream gallery forests, and source-area ponds and cienegas (Rosen and Schwalbe 1988). They are most often found in well vegetated areas and are seldom seen more than 50 feet from permanent water (Rosen and Schwalbe 1988).	Extremely unlikely to occur. No extant or previously existing populations are known from the project area.
Maricopa tiger beetle (*Cicindela oregona maricopa*)	Occurs primarily along the upper tributaries of the Verde, Salt, and Gila rivers (McKown, no date). This species is associated with sandy streambanks and less commonly with gravel and clays along streambanks (McKown, no date).	Occasionally may occur

Potential for occurence is defined as follows: **Extremely Unlikely to Occur** (the study area is outside the species known range); **Unlikely to Occur** (habitats are not typical of those known to be used by this species); **Occasionally may Occur** (may occur during migration, dispersal, or while foraging, but habitats are not typical of those known to be used for breeding and/or no individuals were recorded during species-specific surveys); **May Occur Regularly** (habitats appear typical of those known to be used for breeding but no species-specific surveys were conducted); **Known to Occur** (species has been observed in the study area). Language used in determination of effect was based on the U.S. Forest Service's 1993 Documentation Desk Guide.

3.6.1.2 Protohistoric and Historic Aboriginal Period

The project area is within the range of the historically known Western Apache and Yavapai Indians (Goodwin 1971; Khera and Mariella 1983). The protohistoric or early aboriginal historic period is very poorly documented. It is not known when these groups inhabited the area, but there is a significant gap between the end of the Salado occupations and the first well-documented use during the historic period. Doyel (1978) has proposed an Apachean occupation of A.D. 1500 to 1864 for the Miami Wash area. He notes elsewhere (Doyel 1976) that Goodwin (1969) has documented the Apache occupation of the immediate area at a site known as Wheatfields, located to the north of the junction of Pinal Creek and Miami Wash. According to Goodwin, the Pinal Band of the San Carlos Apache utilized the floodplain for farming, with fields spread over a distance of six miles along Pinal Creek. The Apache abandoned the area in 1864 due to an Anglo attack.

3.6.1.3 Historic Euro-American Period

The Globe-Miami area has been the scene of cattle ranching and mining since the late 1800s. The Silver King Mine was established near Superior in 1875, and production continued to be high there until about 1893. A road was constructed from the Superior to Globe area in the 70s, and there was some mining of silver in the Globe area during that decade. During the period from 1880 to 1893, silver mining continued in Arizona, and there was an increase in hard-rock (as opposed to placer) mining for gold. In addition, there was a growing interest in mining of copper, brought on, first, by an increase in demand that resulted from the increased use of electricity, second, by technological developments (construction of copper concentrators) that made it possible to profitably exploit low-grade ores like those commonly found in Arizona, and third, by the arrival in Arizona of railroads, which reduced the costs of production (Dunning 1966). By the late 1880s, copper was being mined in the Globe area on a sustained basis.

During the period 1893 to 1907, the competitive standing of Arizona's relatively low-grade copper ores was improved by the depletion of the much richer ores in the Butte, Montana and Lake Superior regions. By the beginning of the period 1907-1918, it had been demonstrated that, if handled in large quantities, low-grade copper ore could be mined profitably. This development inspired a search for such ore bodies, for example in the Globe area. The Miami mine was one of the first "large tonnage, low-grade mines to come into production in Arizona" (Dunning 1966). Success of this and other mines in the Globe area led to the construction of a large smelter. Following low production after World War I, production of copper in Arizona rose through the 1920s (SWCA, Inc. 1995b).

The period 1931 to 1945 corresponds to the years of the Great Depression and of World War II. Although copper production in Arizona fell sharply between the stockmarket crash of 1929 and 1932, none of the state's larger mining operations was forced into bankruptcy; however, many mines closed. From 1932, production rose gradually through the rest of the decade, then rose abruptly during World War II.

3.6.2 Site Survey Results

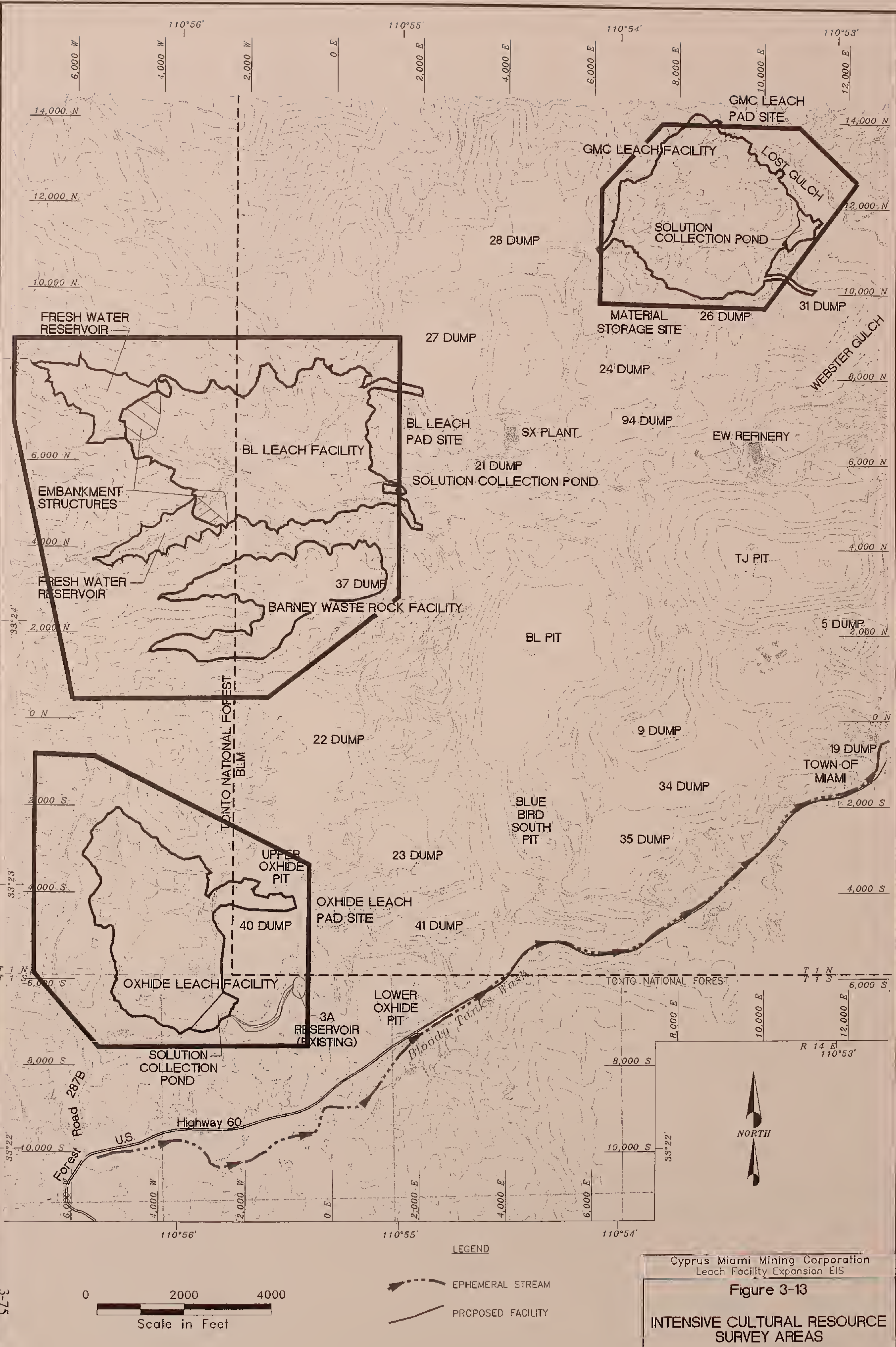
In May and June, 1994, an intensive cultural resource survey was conducted of three parcels of land totalling approximately 2,900 acres and encompassing the proposed project facility areas (SWCA, Inc. 1995b). The survey was conducted in order to locate and describe any cultural resources that might be impacted by the proposed project on lands administered by the Phoenix District BLM, the Forest Service, and patented lands owned by Cyprus Miami. Work on the Phoenix District BLM-administered lands was conducted under BLM Cultural Resource Use Permit No. AZ-000114; work on the Forest Service lands, under Permit No. 4306-02. The bulk of the survey was conducted in unsurveyed portions of T.1N., R.14E., in Gila County, Arizona. A portion of one of the parcels extended into Sections 3 and 4 of T.1S., R.14E., also in Gila County (**Figure 3-13**).

A total of 43 cultural resource (i.e., archaeological) sites were located during the survey. Of the 43 sites, 20 are found on lands administered by Forest Service, 11 on lands administered by Phoenix District BLM, and 12 on Cyprus Miami patented lands. **Table 3-19** lists the 43 sites and their characterization.

Thirty of the cultural resource sites were recorded in the BL Leach Pad parcel and the GMC and Oxhide Leach Pad parcels contained eight and five, respectively. The investigators recommended that all of the cultural resource sites be considered potentially eligible for the National Register of Historic Places. To date, none of these sites has been identified as having had any traditional cultural or religious values. These will be determined in consultation with interested or potentially-affiliated Tribes.

The 43 sites include 20 prehistoric sites, 20 historic sites, and three sites containing both prehistoric and historic materials. In the following summary, the prehistoric and historic components of the latter three sites are counted separately for descriptive purposes. Prehistoric sites vary from small, sparse artifact scatters to a small multi-room pueblo. The majority (13) are small artifact scatters (6) or field houses associated with artifact scatters (7). Simple habitation structures were identified at three sites, and the remains of a more complex multi-room pueblo was identified at a fourth. Two additional alignments may be the remains of collapsed structures. The remaining four sites include an extensive artifact scatter, a cluster of stone check dams, and two artifact scatters with roasting pits. The historic sites vary from small artifact scatters to mining and ranching complexes. Most of the historic sites (10) are mine or mill sites varying from adits with little associated material to large mine and mill complexes. Five of the sites are wagon road segments that were probably haul roads associated with the mining sites. The remaining eight sites include a trash scatter, three sites with building remnants (foundations or wall remnants) that were not securely identified to function, two habitation sites, an extensive complex of historic check dams, and the Bohme Ranch.

The cultural resource sites include 16 sites of unknown, prehistoric origin, most of which appear to be artifact scatters; 2 sites of unknown, ceramic period prehistoric origin, also evidenced by



Source: Golder Associates, Inc.

Cyprus Miami Mining Corporation
Leach Facility Expansion EIS

Figure 3-13

INTENSIVE CULTURAL RESOURCE SURVEY AREAS

GREYSTONE

artifact scatters; 5 sites most likely of Salado origin, also prehistoric, evidenced by artifact scatters and remnants of architectural features; and 23 sites of Euro-american, origin from the later part of the historic period including adits and mine excavations, road remnants, architectural features and standing structures, and water control structures. At least one of the unknown prehistoric sites may also contain evidence of Apache or Yavapai occupation during the early historic period. A breakdown of sites by project component indicates the following:

- Study parcel for Oxhide leach facility — 5 sites (all Euro-american, historic)
- Study parcel for BL leach facility and Barney waste rock site — 30 sites, including 14 unknown, prehistoric; 5 Salado; and 9 Euro-american, historic; and 2 sites with both prehistoric and historic components.
- Study parcel for GMC leach facility — 8 sites, including 1 unknown, prehistoric; and 6 Euro-american, historic; and 1 site with both prehistoric and historic components.

These sites are currently being reviewed by the BLM, Forest Service, and State Historic Preservation Office to evaluate their eligibility for the National Register of Historic Places.

In addition to the sites, a total of 34 isolated occurrences were identified, along with 40 "non-site features" — isolated features such as mining test pits that did not meet the site definition criteria of the Arizona State Museum and the Forest Service and in accordance with guidelines approved by the State Historic Preservation Officer, were considered to lack significance when taken individually. Remains falling into both of these categories were noted and plotted on field maps. Isolated occurrences and non-site features will be included in any future settlement studies of the area and will be evaluated for their potential for having traditional cultural or religious values.

3.7 SOCIOECONOMICS

This section describes aspects of the existing socioeconomic structure of Gila County and the Globe-Miami area including population, the economy, housing, community services, and financial resources. These data will be used to examine the impacts to the socioeconomic infrastructure that would result from implementation of the proposed project or the alternatives.

Gila County is the study area for socioeconomic resources. The Globe-Miami area, which has historically been dominated by mining activities, is the primary area affected by the project. This primary area includes the incorporated towns of Globe and Miami, Arizona and the unincorporated urban area between them (including the unincorporated towns of Claypool, Central Heights, and Midland City, Arizona). This area will be referred to as the "Globe-Miami" area hereafter. This discussion also includes socioeconomic information regarding the San Carlos Indian Reservation (Apache Tribe), which is located 11 miles east of the Globe-Miami area.

Table 3-19. Summary of Cultural Sites Identified During the Cyprus Miami Survey

Site No.	Land Status	Site Type	Cultural-Temporal Affiliation
AR-03-12-02-528	Forest Service	Lithic scatter	Unknown/prehistoric
AR-03-12-02-532 AZ V:9:326 (ASM)	Forest Service	Lithic scatter	Unknown/prehistoric, historic
AR-03-12-02-533 AZ V:9:333 (ASM)	Forest Service	Habitation	Unknown/prehistoric
AR-03-12-02-534 AZ V:9:334 (ASM)	Forest Service	Mining road	Euro-american/historic
AR-03-12-02-535 AZ V:9:335 (ASM)	Forest Service	Field house (?)/artifact scatter	Unknown/prehistoric
AR-03-12-02-536 AZ V:9:336 (ASM)	Forest Service	Roasting pit/lithic scatter	Unknown/prehistoric
AR-03-12-02-537 AZ V:9:338 (ASM)	Forest Service	Field house/artifact scatter	Unknown/ceramic period prehistoric
AR-03-12-02-538 AZ V:9:339 (ASM)	Forest Service	Habitation	Salado—pre-Roosevelt phase?
AR-03-12-02-539 AZ V:9:340 (ASM)	Forest Service	Field house(?)/lithic scatter	Unknown/prehistoric
AR-03-12-02-540 AZ V:9:341 (ASM)	Forest Service	Artifact scatter/mining activity	Euro-american/historic
AR-03-12-02-541 AZ V:9:348 (ASM)	Forest Service	Field house?	Unknown/prehistoric?
AR-03-12-02-542 AZ V:9:350 (ASM)	Forest Service	Habitation?	Euro-american/historic
AR-O3-12-02-935 AZ V:9:177 (ASM)	Forest Service	Water-control system	Euro-american/historic
AZ V:9:53 (ASM) AR-03-12-02-545 AR-03-12-02-1338	Cyprus Miami	Field house(s)/lithic scatter	Unknown/prehistoric
AZ V:9:327 (ASM) AR-03-12-02-1339	BLM	Artifact scatter	Salado?
AZ V:9:328 (ASM)	BLM	Field house/lithic scatter	Unknown/prehistoric
AZ V:9:329 (ASM) AR-03-12-02-543	Cyprus Miami	Habitation	Salado?
AZ V:9:330 (ASM) AR-03-12-02-544	Cyprus Miami	Field house/artifact scatter	Unknown/prehistoric
AZ V:9:331 (ASM) AR-03-12-02-552	Cyprus Miami	Habitation	Euro-american historic
AZ V:9:332 (ASM) AR-03-12-02-546	Cyprus Miami	Habitation	Salado

Table 3-19. Summary of Cultural Sites Identified During the Cyprus Miami Survey

Site No.	Land Status	Site Type	Cultural-Temporal Affiliation
AZ V:9:337 (ASM) AR-03-12-02-547	Cyprus Miami	Ranch	Euro-american historic
AZ V:9:342 (ASM)	BLM	Field house/artifact scatter	Salado
AZ V:9:343 (ASM)	BLM	Field house(?)/artifact scatter	Unknown/prehistoric?
AZ V:9:344 (ASM)	BLM	Check dams	Unknown/prehistoric
AZ V:9:345 (ASM) AR-03-12-02-548	Cyprus Miami	Artifact scatter	Unknown/ceramic-period
AZ V:9:346 (ASM) AR-03-12-02-549	Cyprus Miami	Roasting pit/artifact scatter	Unknown/prehistoric
AZ V:9:347 (ASM) AR-03-12-02-550	Cyprus Miami	Historic mining/prehistoric artifact scatter	Euro-american historic/unknown prehistoric
AZ V:9:349 (ASM)	BLM	Trash scatter	Euro-american/historic
AZ V:9:351 (ASM) AR-03-12-02-551	Cyprus Miami	Mining activity	Euro-american/historic
AZ V:9:352 (ASM)	BLM	Habitation/artifact scatter	Euro-american historic/unknown prehistoric
AZ V:9:353 (ASM)	BLM	Storage?	Euro-american/historic (?)
AZ V:9:354 (ASM)	BLM	Resource processing/ procurement	Unknown/prehistoric
AZ V:9:355 (ASM)	BLM	Habitation	Euro-american/historic
AZ V:9:368 (ASM)	BLM	Mine	Euro-american/historic
AZ V:9:369 (ASM) AR-03-12-02-1336	Cyprus Miami	Mine	Euro-american/historic
AZ V:9:370 (ASM) AR-03-12-02-1337	Cyprus Miami	Mine waste	Euro-american/historic
AZ V:9:371 (ASM)	Forest Service	Mine (adit)	Euro-american/historic
AZ V:9:372 (ASM)	Forest Service	Mine (adit)	Euro-american/historic
AZ V:9:373 (ASM) AR-03-12-02-1340	Forest Service	Mine (adit)	Euro-american/historic
AZ V:9:374 (ASM) AR-03-12-02-1341	Forest Service	Road fragment	Euro-american/historic
AZ V:9:375 (ASM) AR-03-12-02-1342	Forest Service	Road fragment	Euro-american/historic
AZ V:9:376 (ASM) AR-03-12-02-1343	Forest Service	Road fragment	Euro-american/historic
AZ V:9:377 (ASM) AR-03-12-02-1344	Forest Service	Road fragment	Euro-american/historic

3.7.1 Population

Table 3-20 describes the population distribution of Gila County based on ethnic, geographic, and economic considerations. The geographical distribution is based on 1993 data collected by the Arizona Department of Economic Security (1994c). The ethnic and economic distribution is based on 1990 data from the U.S. Bureau of Census.

The population of Gila County has grown slowly but rather steadily over the past two decades, from 29,255 in 1970 to 43,400 in 1994. Fluctuations are directly related to changing conditions in the local copper industry.

Table 3-20. Population Distribution

Ethnic Distribution (Gila County)		Geographical Distribution		Economic Distribution	
Percent of Population	Race/Ethnicity	Area	Population	Area	Population Below Poverty level
76.5	White (Not Hispanic)	Total Gila County	42,400	Gila County	7,234 (18%)
18.6	Hispanic	Incorporated towns of Globe & Miami and unincorporated areas between.[3]	13,000 (or 33%)	Incorporated towns of Globe & Miami & unincorporated areas between.[3]	21% - 23%
13	American Indian [1], [2]	San Carlos Indian[2] Reservation	10,500	San Carlos Indian Reservation	58%
0.2	African American				
0.3	Asian American				
0.2	Other				

[1]There are 256 American Indian residents in the Miami-Globe primary study area, accounting for 5 percent of the total American Indian population in Gila County.

[2]2,822 American Indians live on the San Carlos Apache Reservation which includes portions of Gila, Graham, Navajo, and Apache counties.

[3]Communities closest to the existing operations of Cyprus Miami and proposed leach facility expansion.

From 1980 to 1990, the population of Gila County increased by about 8 percent, one of the slowest growth rates in Arizona during that decade (Leaming 1995). During that same decade,

the population of the Globe-Miami urbanized area actually declined by about 11 percent from nearly 14,600 in 1980 to less than 13,000 in 1990. Virtually all of the net population increase in Gila County from 1980 to 1990 was in the Payson area, in the northern part of the county, and on the San Carlos Indian Reservation, east of the Globe-Miami area. Since 1990, however, the Globe-Miami area has shared in the county's population growth rate and has helped increase the population by 13 percent since 1985.

3.7.2 Environmental Justice

On February 11, 1994, Executive Order 12898, "Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations" (Order) was published in the Federal Register (59 FR 7629). The Order requires federal agencies to identify and address disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations. The low income population (defined as those living below the poverty level) and minority populations for the study area are shown in **Table 3-20**.

3.7.3 Employment

The Cyprus Miami operations currently employ approximately 950 persons, of which an estimated 309 are employed at the Cyprus Miami mine and about 116 employed in the associated leaching/SW-EW facilities. **Table 3-21** describes the labor force in the study area. It includes information on employment and unemployment for 1993, 1994, and 1995 for Gila County, the Globe-Miami area, and the San Carlos Indian Reservation. In the 12 months ending June 30, 1994, there were less than 200 persons employed in agriculture in Gila County. Most of those were employed in rural areas of the county, outside of the Globe-Miami urbanized area.

3.7.3.1 Employment - Gila County

The 1994 unemployment rate for Gila County (7.3 percent) was the county's lowest rate in three years. This figure was less than a third of the rate that had been experienced in 1983 when cutbacks in the copper industry sent the Gila County unemployment rate up to 25.4 percent. For the period of 1980 through 1994 the county's unemployment rate has oscillated between 7.4 percent and 25.4 percent, with the rate remaining under 11 percent since 1989.

3.7.3.2 Employment - Globe-Miami Area

The 5.6 percent unemployment rate for 1994 as shown in **Table 3-21** reflects the relatively strong demand for workers in the prosperous local economy as compared to county-wide figures. When the 22.1 percent rate shown for the San Carlos Apache Indian Reservation is added to the rate for the Globe-Miami area, the Globe-Miami area rate approximates 7.8 percent, which is closer to the county-wide rate of 7.4 percent. This is considerably greater than the unemployment rate in the state's largest metropolitan area (Leaming 1995).

3.7.3.3 Employment - San Carlos Indian Reservation

The 1994 unemployment rate for the San Carlos Indian Reservation shown in **Table 3-21** (22.1 percent) is almost four times the rate for the Globe-Miami area and more than double the county-wide rate.

Table 3-21. Study Area Labor Force Information

Year	Labor Force	Employment	Unemployment Rate (percent)	Number Unemployed	Non-Agricultural Workforce Employed in Mining (percent)
Gila County					
1993	18,625	15,419	8.9	1,506	7.1
1994	19,333	17,916	7.3	1,417	10.4
1995*	18,625	17,150	7.9	1,475	NA
Globe-Miami Area					
1993	5,971	5,580	6.5	391	NA
1994	6,464	6,102	5.6**	362	NA
1995	4,373	4,155	8.9	218	NA
San Carlos Indian Reservation					
1993	932	698	25.1	234	NA
1994	979	763	22.1	216	NA
1995	1031	810	21.4	221	NA

*For 12-month period ending August 1996
**If labor market for San Carlos Indian Reservation is included, the unemployment rate is 7.8 percent.
NA = Not Available

Source: Arizona Department of Economic Security (1995b)

3.7.3.4 Employment - Environmental Justice Issues

The unemployed population in 1993 (for Gila County, including San Carlos Indian Reservation) is broken down into the following percentages by ethnicity:

White (not Hispanic)	57 percent
Hispanic	22 percent
American Indian	21 percent

3.7.4 Personal Income

Wages for employees in government and in the mining industry are somewhat higher than those for employees in the services and trade industry. Therefore, the amount of wages represents a more accurate measure of the relative importance of the various industries to the overall economy than do the official employment figures, which count all jobs alike, regardless if they are full-time, part-time, high-pay or low-pay.

Total personal income received by the residents of Gila County has risen markedly since the early 1980s, more than doubling since the recession of 1982, ($318.8 million in 1981 to $651.7 million in 1993, the latest year for reliable information).

Personal income consists of: 1) earned income (**Table 3-22**); 2) dividends, interest, and rent income; and 3) net transfer payments. The breakdown of sources of personal income for Gila County in 1993 follows:

Earned Income (wages, salaries, profits from current efforts)	57 percent	$373.6 million
Dividends, Interest and Rent	15 percent	$98.7 million
Transfer Payments (retirement and welfare)	28 percent	$179.4 million

3.7.4.1 Earned Income

The earned income described above is derived from the following sources:

Table 3-22. Sources of Earned Income

Earnings by Industry	Amount	Percent
Agriculture, forestry, and related	$4,649,000	1.2
Mining	48,118,000	12.9
Construction	26,897,000	7.2
Manufacturing	82,040,000	22.0
Transportation and public utilities	18,827,000	5.0
Wholesale and retail trade	50,816,000	13.6
Finance, insurance, and real estate	7,743,000	2.1
Services	63,209,000	16.9
Federal government	19,286,000	5.2
State and local government	52,033,000	13.9
Total	$373,618,000	100

Source: Leaming 1995.

Earned income includes basic (or imported) personal income. Imported income is the income that is derived from selling products or services to people or organizations outside of the county. This imported income can be from direct sales of services or products outside the county or from local recirculation of imported income within the county. The imported income for 1993 in Gila county is distributed as follows:

Retirement and welfare (includes payments to the San Carlos Indian Tribe)	51 percent
Copper industry mining and manufacturing	36 percent
Federal and State government	9 percent
Agriculture, Forestry, and Tourism	4 percent

3.7.5 Housing

In 1990, Gila County had approximately 14,950 year-round housing units, of which 12,847 (86 percent) were occupied. Of those occupied units, 9,922 (77 percent) were owner-occupied. Since 1990, more than 3,000 housing units have been added to the county's housing supply by new construction. Much of that new housing, however, was built in the Payson area of northern Gila County, although a number of units were also built in the unincorporated area between Globe and Miami (Leaming 1995).

In the four years following the 1990 Census, more than 170 new residential units were added within the City of Globe but fewer than 20 were built within the Town of Miami. From 1991 through 1994, more than 1,600 housing units were added in the unincorporated areas of the county (Butler 1995).

3.7.6 Utilities

Electrical energy is provided to the residents and most businesses of the Globe-Miami area by the Arizona Public Service Company of Phoenix. The Salt River Project, an electric power cooperative headquartered in Phoenix, supplies power to the major mining companies that operate in the area, including Cyprus Miami.

Natural gas is supplied in the Globe-Miami areas by the Southwest Gas Corporation of Las Vegas, Nevada. Local telephone service is provided by U.S. West Communications of Denver, Colorado.

Within the City of Globe, both water and sewer facilities are operated by the City. In other parts of the Globe-Miami area, domestic water is supplied by private water firms while sewer service is provided either by the Town of Miami, special sanitary districts, or by private systems.

3.7.7 Education

Primary and secondary education was provided to 3,877 students in the Globe-Miami area during the 1993/1994 school year by two public school districts, the Globe Unified School District and the Miami Unified School District. The Proposed Action is located in the Miami Unified School District, which served 1,298 elementary school students and 565 high school students during the 93/94 school year. This enrollment is, not quite half of the total for both districts (Bishop 1994). Total enrollment in these districts has grown about three percent over the past three years (Bishop 1994).

In 1993 and 1994, the two school districts in the Globe-Miami area had total revenues of almost $17 million, with virtually identical amounts (44.7 percent each) coming from local sources (mostly property tax) and from state aid (mostly through the direct distribution of state sales and severance tax revenues). The remaining 11 percent was split almost evenly between federal aid and special aid from Gila County (Bishop 1994).

The Miami Unified School District has been much more dependent upon the property tax than the Globe Unified School District. In 1993 and 1994, the Miami School District received more than $5.6 million (68 percent) of its $8.3 million revenues from local sources, mainly the property tax. Only $2.0 million (24 percent) came from state aid, about 5 percent came from federal aid, and less than 3 percent from Gila County (Bishop 1994).

The Globe-Miami area of Gila County is also serviced by a two-year community college, the Gila Pueblo Campus of Eastern Arizona College, with its Gila County campus located at Globe. Like the elementary and high school districts, the community college is supported largely by local property taxes and by appropriated state aid.

3.7.8 Public Safety

Law enforcement in the Globe-Miami area is provided by the Gila County Sheriff's Department and municipal police departments in Globe and Miami. In addition, the Arizona Department of Public Safety maintains a Highway Patrol Station in the area and regularly patrols local and state highways.

Fire protection is provided in Globe and Miami by municipal fire departments. In the unincorporated areas of the Globe-Miami area, fire protection is provided by the Central Heights, Tri-City, and Canyon Fire Districts. Emergency services in the Globe-Miami area are provided by Gila County, the two municipalities, the fire districts, the Arizona Department of Public Safety, the Forest Service, and BLM.

3.7.9 Health Care

Primary health care in the Globe-Miami area is provided by 18 full-time physicians (MDs), 33 part-time physicians, three chiropractors, and eight dentists. Hospital care is provided by the

Cobre Valley Community Hospital, which provides acute care service, including emergency services and a wide range of diagnostic services. This hospital's staff includes specialists in surgery, orthopedics, radiology, and family practice.

Other medical facilities include one medical clinic and two nursing homes. In addition, home health care is provided to local residents by Gila Aging Services. Mental health services are provided by the Gila Guidance Clinic and several local psychologists who are engaged in private practice (Az Dept. Comm 1996).

3.7.10 Other Community Services

Local governments in the Globe-Miami area maintain and operate five parks, six baseball fields, and three public swimming pools. Gila County also maintains the fairgrounds and park just northwest of Globe. The area also has one nine-hole golf course, two public libraries, and a small mining museum.

3.7.11 Tax Base and Business Expenditures

Gila County receives a portion of its revenues from property taxes and part from the disbursement of severance, sales, and other taxes from the State of Arizona under a formula established by legislation and based on local property taxes levied and total collections of state sales and other taxes within the county. In the fiscal year that ended June 30, 1994, Gila County received $3,556,665 from the state government through such revenue disbursements (Leaming 1995). That same year, Gila County levied $11,978,133 in county property taxes. Gila County also receives payment in lieu of taxes (PILT). In fiscal year 1994, the County received $744,311 in PILT payments. In 1994, the property tax base of Gila County was valued at nearly $268 million. The category of producing mines and timber accounted for about 36 percent of the total property tax base valuation in the County (Leaming 1995).

The incorporated municipalities of Globe and Miami get their revenues from local sales taxes, local property taxes, and the disbursement of state sales, severance, and other taxes based on population. Property taxes form a relatively small part of municipal government revenues in Gila County, with most revenues coming from locally-imposed sales taxes and disbursements of state sales taxes. In 1994, the Town of Miami received about $300,000 in shared sales, severance, and income taxes from the State of Arizona and about $140,000 in municipal property taxes (Leaming 1995).

School districts get their revenues from the taxes levied on the property located within their jurisdictions and through the disbursement of state sales and other taxes, including mining severance taxes. These disbursements are based on a formula established by law and depend in part, on average daily student enrollment and on local tax effort as well as certain student population characteristics. In 1994, the property tax base of the Miami Unified School District was valued at $92 million. The category of producing mines and timber accounted for nearly $68 million or 73 percent of the property tax base valuation of the district.

In 1993 and 1994, the Miami Unified School District (within which the Cyprus Miami property lies) received about 68 percent of its revenues from its property tax and about 24 percent from the distribution of state-levied sales and severance taxes. Another 5 percent came from federal sources, while 3 percent came from the Gila County government.

3.7.11.1 State and Local Taxes Paid Directly

Based on the current rate of production at the expanded Cyprus Miami Leach Facility, an average copper price during the period of full production equal to that realized by Cyprus Amax Minerals Company on its other production in 1994, and existing Arizona tax rates and assessment practices, Cyprus Miami is estimated to pay an average of $6,075,000 each year in state and local taxes. The total includes an estimated average of $1,380,000 in severance taxes paid each year to the State of Arizona, part of which is distributed to the various counties, municipalities, and school districts throughout the state. The tax total also includes about $3,095,000 each year in property taxes, $946,000 in sales and use taxes, $380,000 in payroll taxes, and $274,000 in other taxes and fees to the State and County each year (Leaming 1995). Most of the $6,075,000 in taxes is then distributed back to the entities shown in **Table 3-23**.

3.7.11.2 Local Purchase of Goods and Services

The current leach facilities incur costs for equipment, spare parts, operating supplies (including chemical reagents), electrical energy, motor fuel, and other products and services. It is estimated that during an average year of full production, $40,698,000 (in 1994 dollars) was paid for these products and services to suppliers located in Arizona. It is estimated that more than 40 percent of that total ($17,317,000) went to suppliers located in Gila County because of the nature of the products and services to be bought and the demonstrated purchasing patterns of Cyprus Miami. Virtually all of the remainder went to suppliers located in Maricopa and Pima Counties.

3.7.11.3 Indirect Business Income

Local business firms operating in Gila County currently receive $22 million in sales each year as an indirect result of Cyprus Miami's direct payments of personal, business, and government income in the county. The accumulated direct and indirect contributions of the copper producing facility to business income in the County amounts to an average of almost $40 million during each year that the facility is operated at full scale production, as shown in **Table 3-24**.

Table 3-23. State and Local Government Tax Revenues Received Directly from the Cyprus Miami Mining Corporation Facility (in 1994 Dollars under 1994 Laws).

Governmental Unit	Annual Net Benefit
State of Arizona	$1,057,000
Gila County	1,445,000
Other County Governments	486,000
Gila Pueblo College	122,000
Miami Unified School District	1,545,000
Other Gila County School Districts	30,000
Other Arizona School Districts	1,020,000
Town of Miami	1,000
Other Gila County Municipalities	2,000
Other Arizona Municipalities	321,000
Special Districts in Gila County	25,000
TOTAL	**$6,054,000**

Source: Leaming 1995; based on data from the Arizona Department of Revenue, the Arizona Tax Research Foundation, the Cyprus Miami Mining Corporation, and other Arizona copper producers.

Table 3-24. Combined Direct and Indirect Annual Impacts of Cyprus Miami on the Economy of Gila County, Arizona (At Full-Scale Production)

TOTAL DIRECT BENEFIT OF:		$34,119,000
Including direct gains in:		
Personal Income of	$13,632,000	
Business Income of	17,317,000	
Local Government Revenues of	3,170,000	
which, because of the circulation and recirculation of income through the county's economy, would result in a:		
TOTAL INDIRECT BENEFIT OF:		$33,784,000
including indirect gains in:		
Personal Income of	$9,826,000	
Business Income of	22,284,000	
Local Government Revenues of	1,674,000	
to create an:		
ACCUMULATED ECONOMIC GAIN OF:		$67,903,000
including combined direct and indirect gains in:		
Personal Income of:	$23,458,000	
Business Income of:	39,601,000	
Local Government Revenues of:	4,844,000	

Source: Leaming 1995

Business firms throughout the state, including those in Gila County, as well as those in other counties, currently receive nearly $131 million each year as an indirect result of the Cyprus Miami Leaching Facility. The accumulated direct and indirect business income from the copper producing operation averages more than $171 million per year during full scale production, as shown in **Table 3-25**.

3.7.11.4 Governments Receiving Revenues Directly

Local governments in Gila County receive a total of $3,170,000 (in 1994 dollars) each year directly from the Cyprus Miami Mining Corporation as a result of operations at the existing leach facility. That includes $1,545,000 paid each year to the Miami Unified School District, mostly in the form of property taxes. Other school districts in the county receive about $30,000 per year, mostly through the apportionment of sales and severance taxes paid to the State of Arizona by Cyprus Miami.

More than $1.5 million is paid each year to Gila County government, mostly in property taxes, which also includes over $120,000 each year to the Gila Pueblo Community College. The Town of Miami receives less than $1,000 per year from the taxes paid by Cyprus Miami through the apportionment of sales and severance taxes. Other incorporated cities and towns in the county receive about $2,000 per year through the same distribution of sales and severance taxes.

Incorporated municipalities outside of Gila County, most of them in Maricopa County, receive more than $320,000 per year from the expanded Cyprus Miami operations, entirely through the apportionment of severance and sales taxes. The automatic apportionment of severance and sales taxes paid on the Miami operations provides more than $1.0 million per year for school districts outside of Gila County. County governments other than in Gila County receive about a third as much as Gila County itself, getting about $490,000 each year that the leach facility is in full production. Most of that amount goes to Maricopa and Pima counties.

The State of Arizona is a substantial beneficiary of the net taxes being paid by the Cyprus Miami leach facility. During each year of production, the State of Arizona receives almost $1.1 million (in 1994 dollars) in the form of property, severance, sales, payroll, and other taxes and fees.

3.7.11.5 Indirect Personal Income

The money received by the company's employees as wages and salaries, by its suppliers as sales receipts, and by state and local governments as taxes, and fees circulate and recirculate a number of times within the local economy and statewide before being dissipated in leakages or outflows to other parts of the national and global economies. As that direct impact money circulates and recirculates, it creates additional indirect personal, business, and government income in a ripple or multiplier effect. As a result of this ripple effect, the direct gains from any enterprise or part of an enterprise, such as the Cyprus Miami leach facility, are multiplied to form a total direct

and indirect gain that is frequently much greater than the direct impact of payrolls, purchase, taxes, and fees paid directly by the enterprise itself.

As the Cyprus Miami leach facility continues to operate at full-scale production, the economic multiplier process generates for the economy of Gila County, an indirect benefit of almost $10 million in personal income per year, as shown in **Table 3-24**. This is in addition to the personal income of $13,632,000 provided directly each year by the copper producing activity. The accumulated direct and indirect benefit in personal income in the Gila County economy is estimated to be $23,458,000 during each year of full production.

The indirect impact on personal income in the Arizona economy is even greater. In addition to the $13,632,000 in direct personal income benefits received each year by Arizona residents as a result of the operation of the Cyprus Miami leach facility, the circulation of the facility's direct injections into the Arizona economy create an added $42.4 million per year of indirect personal income for Arizona residents, as shown in **Table 3-25**. Combined with the personal income provided directly by the facility to its Miami employees, this generates an accumulated direct and indirect personal income benefit for Arizona residents of $56,002,000 during each year of full production at Cyprus Miami.

Table 3-25. Combined Direct and Indirect Annual Impacts of Cyprus Miami on the Economy of Arizona (At Full-Scale Production)

TOTAL DIRECT BENEFIT OF:		$60,384,000
Including direct gains in:		
Personal Income of	$13,632,000	
Business Income of	40,698,000	
State and Local Government Revenues of	6,054,000	
which, because of the circulation and recirculation of income through the Arizona economy would result in a:		
TOTAL INDIRECT BENEFIT OF:		$181,787,000
including indirect gains in:		
Personal Income of:	$42,370,000	
Business Income of:	130,594,000	
State and Local Government Revenues of:	8,823,000	
to create an:		
ACCUMULATED ECONOMIC GAIN OF:		$242,171,000
including combined direct and indirect gains in:		
Personal Income of:	$56,002,000	
Business Income of:	171,292,000	
State and Local Government Revenues of:	14,877,000	

Source: Leaming 1995

3.7.11.6 Indirect Employment

The generation of $9,826,000 annually of personal income indirectly in Gila County as a result of operation of the Cyprus Miami leach facility indirectly supports approximately 540 jobs in the Gila County economy, in addition to the 309 jobs supported directly by the existing leach facility. That represents employment support for about 849 jobs in Gila County. Most of the 540 jobs supported indirectly by the Cyprus Miami leach facility are in trade, services, and some in government. Virtually all of these jobs are filled by residents of the Globe-Miami area.

The generation of $42,370,000 of personal income indirectly throughout Arizona each year by the operation of the Cyprus Miami leach facility supports almost 1,800 jobs indirectly in the state's economy. Most of those jobs are in government, trade, and services.

Combined with the 309 jobs provided directly in the mining sector by the Cyprus Miami leach facility, this represents a net benefit to the Arizona employment level of about 2,100 jobs. With an average of over 117,500 unemployed statewide in 1994, these jobs affect the state unemployment rate by about 0.1 percent.

3.8 LAND USE

3.8.1 Land Status/Ownership

Current land use and land ownership in the project area and vicinity were mapped and tabulated using the Forest Service map, and grazing allotment and recreation maps also provided by the Forest Service. In addition, current and proposed land management plans for the area and their constraints were identified. These include the Forest Service Land and Resource Management Plan and Final Environmental Impact Statement and the BLM Phoenix Resource Area Management Plan and Final Environmental Statement (Forest Service 1985a and 1985b; BLM 1988).

More than half of the total acreage in Gila County is federal land. Most of the federal land is National Forest System land, which accounts for 56 percent of the area in the County. The Apache Indian Reservation accounts for 37 percent. Private lands account for 3 percent. State of Arizona and other public lands account for 2 percent. Lands administered by the BLM account for the remaining 2 percent of lands in the county. The primary uses of land in the county are copper mining, ranching, and timberland (Arizona Dept. of Commerce 1993).

The Cyprus Miami mining area is located on public and private lands in the Globe-Miami Mining District in Gila County, Arizona. The interior of the district contains a patchwork pattern of land ownership consisting of private, BLM, and state owned lands. The Forest Service surrounds the area to the north, west, and south. The San Carlos Indian Reservation is located east of the Globe-Miami region. The federal lands in the project area are administered by the Globe Ranger District of the Forest Service and the Phoenix Resource Area of the BLM. **Figure 3-14** shows the distribution of land ownership in the Globe-Miami area.

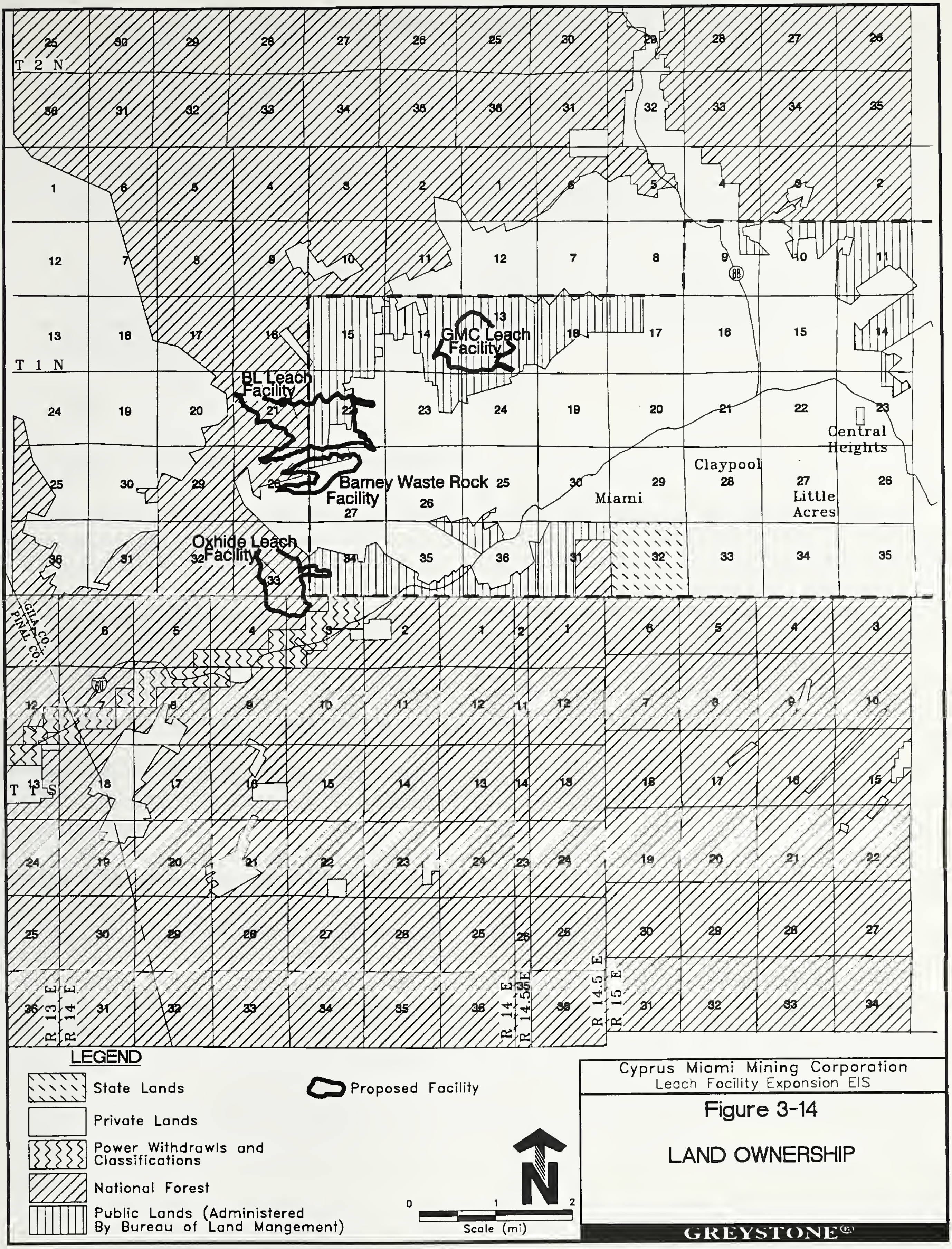


Figure 3-14

LAND OWNERSHIP

The Cyprus Miami mining facilities are located on a combination of fee property owned by Cyprus Miami, patented and unpatented mining and mill site claims, and private and state leases (CMMC 1994). The unpatented claims are located on Forest Service and BLM lands. Unpatented lands are administered by a federal land management agency and are subject to valid existing mining claims. Patented lands are privately owned lands that have been acquired by complying with the processes set forth in the 1872 Mining Law or other federal land laws.

Cyprus Miami and the BLM are currently in negotiations for a potential land exchange, which may include the federal lands affected by the proposed action. Once the proposed list of federal and non-federal lands to be included in the exchange have been agreed upon, the BLM will prepare an EIS for the proposed land exchange.

3.8.2 Land Use Plans

3.8.2.1 Forest Service Management

The Cyprus Miami project area is located in and comprises a relatively small portion of Management Area 2F of the Globe Ranger district of the Forest. Management Area 2F consists of nearly 386,000 acres. Primary emphasis for the management area is to manage for a variety of renewable natural resources, with the focus on wildlife habitat improvement, water quality maintenance, livestock forage production, and dispersed recreation. The Tonto National Forest Plan also calls for the support of environmentally-sound energy and minerals development (USDA Forest Service 1985a). There is no acreage suitable for timber production and harvest. The primary land use of the management area in the vicinity of the Miami mine consists of several existing mining operations, as well as, livestock forage production and wildlife habitat.

3.8.2.2 BLM Management Plan

Other federal lands in the Globe-Miami area are administered by the Phoenix Field Office of the BLM. The area is managed for grazing and mining under provisions of the Phoenix Resource Area Management Plan (BLM 1988).

3.8.2.3 Gila County Land Management

The Gila County Comprehensive Plan is currently being developed by county planners. Land use practices in the county are managed through zoning regulations. Most of the private lands in the mining area located north of the towns of Miami and Claypool are zoned M2-Industrial Two District under Gila County zoning regulations. The M2 zoning designation provides for heavy industry, including all types of commercial and industrial uses. Controls may be imposed to minimize air pollution, radiation, and/or explosion dangers. Mining operations are exempted by statute from county planning and zoning ordinances.

3.8.3 Existing Land Use

3.8.3.1 Grazing

The project area includes portions of three Forest Service grazing allotments and one BLM grazing allotment (**Figure 3-15**). The Forest Service allotments are the Bellevue, Bohme, and Sleeping Beauty allotments, and the BLM allotment consists of the Lost Gulch grazing allotment.

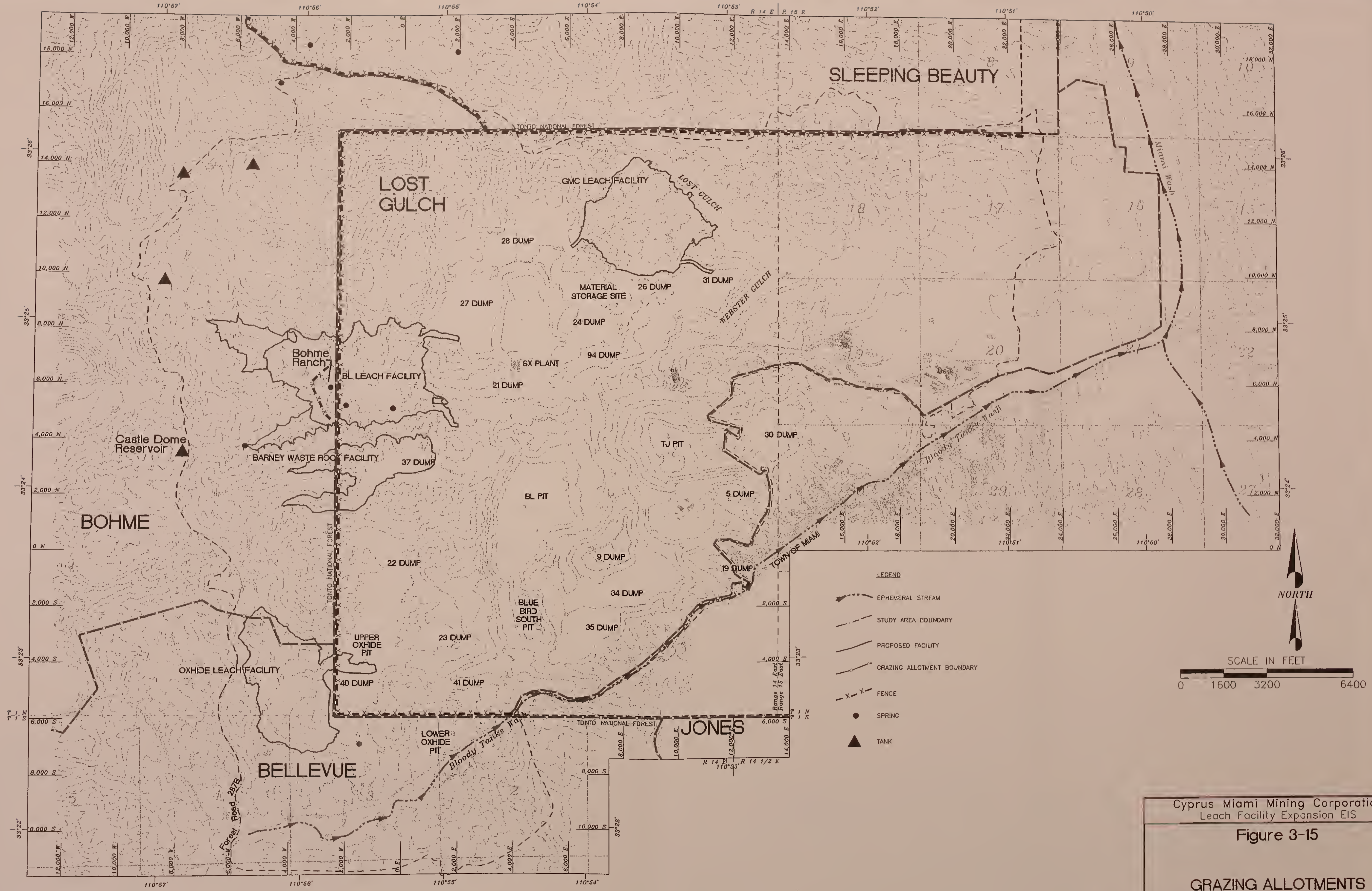
There are currently no approved Allotment Management Plans for the Bohme and Sleeping Beauty allotments. A grazing permit issued by the Forest Service authorizes Cyprus Miami, the designated permittee, to graze livestock in both allotments. Both contain National Forest System lands and land controlled by Cyprus Miami and BHP Copper Company. On both allotments, the permittee is to construct and maintain range improvements.

Portions of the Bohme Allotment are located within the project area boundaries and to the west of the mining area. Cyprus Miami is the only permittee for this allotment. There are 5,740 acres administered by Forest Service and a large portion of private land within the allotment. The grazing permit for this allotment has been issued for 145 head of cattle. This includes 85 head of cattle for a period of use from January 1 to December 31, and 60 yearlings for a grazing period from January 1 to May 31, for a total of 1,186 Animal Unit Months (AUMs).

Portions of the Sleeping Beauty Allotment are located within the project area boundaries and to the north of the mining area. The grazing permit issued for this allotment permits 128 head of cattle. This includes 93 head of cattle for a period of use from January 1 to December 31, and 35 yearlings for a grazing period from January 1 to May 31, for a total of 1,291 AUMs.

A portion of the Bellevue Allotment is located within project boundaries in the southwest portion of the project area. The allotment has 17,539 acres and a year-round yearling and cow/calf operation with a total of 1,053 AUMs.

The Bellevue Grazing Allotment has three permittees: Cyprus Miami, Robert Mounce, and Kathy Williams. Cyprus Miami is permitted for 15 adults from January 1 to December 31, and 15 yearlings from January 1 to May 31. Robert Mounce is permitted for 45 adults from January 1 to December 31, and 22 yearlings from January 1 to May 31. Kathy Williams is permitted for 16 adults from January 1 to December 31, and 19 yearlings from January 1 to May 31. The Allotment Management Plan requires the permittees to rotate cattle through the pastures in the allotment. The proposed facility sites are located within those portions of the grazing allottment controlled by Cyprus Miami. An approved EA with an up-to-date management plan will be in place by December 31, 2001 on the Bohme, Sleeping Beauty and Bellevue allotments.



Cyprus Miami Mining Corporation
Leach Facility Expansion EIS

Figure 3-15

GRAZING ALLOTMENTS

GREYSTONE

Forest-wide direction for range management is to bring the permitted grazing use in balance with the forage allocated for use by domestic livestock and to have all allotments under appropriate levels of management. Management prescriptions in Management Area 2F are to treat range that is in less-than-satisfactory condition with improved grazing management along with the installation of structural and non-structural improvements. Suitable rangelands are managed at Range Resource Management Level D. This level seeks to optimize production and utilization of forage allocated for livestock use consistent with maintaining the environment and providing for multiple use of the range.

BLM lands within the project area are part of the Lost Gulch grazing allotment. Cyprus Miami has been issued a permit to graze cattle on this allotment. The grazing permit has been issued for 27 head of cattle for a grazing period from March 1 to February 28, for a total of 324 AUMs.

Grazing improvements on public lands in the vicinity of the proposed project facilities on these allotments are shown in **Figure 3-15** and listed in **Table 3-26**. Improvements in this area include livestock watering tanks, spring developments, and fence segments. The boundary fence shown on the Plan of Operation map is maintained by Robert Mounce.

Table 3-26. Grazing Improvements in Facility Disturbance Areas

Allotment	Improvement Name	Improvement or ID Number
Bohme	Bohme NF Boundary Fence	001730
	Bohme-Bellevue Fence	00173[illegible]
	HDQ Pasture Fence	00173[illegible]
	Buckhorn Spring	00173[illegible]
	Unamed Tank (Frog)	_____
	Mexican Tank	39-000530
	Goldfish Pond (Tank)	NA
Bellevue	Bellevue-NF Boundary Fence	NA
	BLM	
Lost Gulch (Number 06014)	Vigor of Life Spring	NA
	Upper Webster Tank	NA
	Middle Webster Tank	NA
	Lower Webster Tank	NA

Source: USDA National Forest Service, 1995a, USDI Bureau of Land Management 1988.

3.8.3.2 Mining

Mining has occurred in the Globe-Miami Mining District since the 1870s. The area was originally mined for gold and silver, although these minerals had diminished by the mid 1880s. Other minerals that have been mined in the district include manganese, asbestos, turquoise, clay, and others. Copper has been mined in the area since the 1880s and copper mining is currently the base industry of the Globe-Miami area. Current mining activity in the area consists of operations conducted by Cyprus Miami and BHP Copper Company. Existing Cyprus Miami mining facilities in the project area consist of several open mine pits that produce ore for heap leaching operations, a solvent extraction-electrowinning plant producing copper cathode, a smelter, a refinery, and a rod mill. Cyprus Miami has authorization, under an existing Plan of Operation and amendments, to conduct mining operations on National Forest System lands in the vicinity (Forest Service No. 89-12-02-003 as amended). They also have an approved Mine Plan of Operations on BLM lands (MPO 81-P-003 as amended) and an approved BLM Plan (AZA 27259).

3.8.3.3 Public Access

The primary access road into the Cyprus Miami mine area is owned and maintained by the mine. It originates at company offices in Claypool on U.S. Highway 60. Numerous access and haul roads connect mine facilities to the main road. These roads are on private lands and are not open to the public. Access is also available from the west of the mine area, as Forest Service road 287B provides access to several roads that lead into BLM and private lands. These access roads are used primarily for grazing operations, although recreationists may occasionally use the area. Roads that lead into mining operations are closed to the public and access is restricted by signs and gates.

3.8.3.4 Utilities

A 115-kV Salt River Project transmission line crosses the project area from the southwest corner to Pinal Creek north of the project area. The line provides power to mining operations. There are two Special Use Permits issued to BHP Copper, Inc., by the Forest Service. The permits authorize a waterline and a slurry pipeline for the use of the Pinto Valley mine. The pipeline is located along the road that accesses the mining area from the west, from Forest Service road 287B. There are no designated utility corridors on BLM lands in the project area.

3.8.3.5 Timber

None of the land within Management Area 2F, including the project area, is suitable for timber harvest. Local residents collect timber for fuelwood in the management area; however, the project area is generally not utilized by the public for this purpose.

3.8.4 Transportation

The only issue raised by the public involved the amount of roads and trails that would be directly affected by the project. The purpose of this section is to describe the existing conditions associated with the use of roads and highways in the study area.

U.S. Highway 60 provides the primary access route connecting the site with Phoenix to the west and the Miami-Globe area to the east. U.S. Highway 60 continues northeast from Globe providing access to the White Mountains and central New Mexico. U.S. Highway 70 runs southeast from Globe providing access to Interstate 10 and southern New Mexico. Arizona State Route 88 extends north from the Globe-Miami area to Roosevelt Lake and the northern part of Gila County. Arizona State Route 77 extends southward from Globe to the Hayden-Winkelman area, San Manuel, and Tucson. U.S. and state highways in the project vicinity are typically paved, all weather, two-lane rural highways with 11- to 12-foot wide travel lanes in good condition.

3.8.4.1 Current Traffic Volumes and Levels of Service

Current traffic volumes are at or below capacity on all major highways in the project area (USDA Forest Service 1995). U.S. Highway 60 in the vicinity of the project site is considered to have an acceptable level of service. U.S. Highway 70 east of Globe and State Route 88 north of Miami exhibit traffic volumes that are reaching capacity for those roadway segments during peak periods.

3.8.4.2 Project Access/Trip Generation

Primary access to the project site is provided via the main mine access at New Street, located along the north side of U.S. Highway 60 near Claypool (**Figure 1-1**). This signalized intersection is used for nearly all heavy trucks and employee traffic. The mine is in operation 24 hours per day in three shifts. Consequently, there are three peak commute periods, as mine employees enter and exit the mine. Average daily traffic through the main gate is about 3,111 vehicles. These vehicles would either originate from or be destined for U.S. Highway 60.

3.8.4.3 Large Truck Accidents

The Arizona Department of Transportation accident data include accidents, categorized by types of vehicles, only for entire routes, such as Highway 60 within Arizona. Accidents involving large trucks on Highway 60 during the past six years have averaged 76 per year (ADOT 1996).

3.8.4.4 Forest Service Road Management

There are only two roads in the study area that experience any appreciable use; Castle Dome Road (Forest Road 287B) and Little Pinto Canyon Road (Forest Road 608). Castle Dome Road

extends north from Highway 60 and traverses the area west of the Forest-BLM boundary. Most of the traffic on Castle Dome Road is for access to the BHP Copper, Inc., Pinto Valley Mine, with minor recreational use of the road. Little Pinto Canyon Road is actually two parallel roadways on opposite sides of the Little Pinto Canyon drainage. The road(s) extends east from Castle Dome Road through Little Pinto Canyon to the Bohme Ranch near the intersection with Lost Gulch. A minimal amount of recreational traffic uses these roads, but the Forest Service does not maintain records of usage for this area.

The Forest Service prepared a Resource Access Travel Management Plan in 1990 with the purpose of identifying future roadway and trail access conditions. The Plan established target objectives to aid in decision-making for maintenance and for project and management activity review. As an evaluation criterion, the plan is useful for identifying the priority roads and trails that may be affected by the proposed project. The majority of roads near the west side of the project area have been identified for closure on the Resource Access Travel Management Plan (Herkenhoff 1995b).

3.9 VISUAL RESOURCES

3.9.1 Existing Visual Resources

The existing mine facilities and disturbances have contributed to the visual character of the Globe-Miami mining district for nearly 100 years. The overall scenic quality of the study area is influenced by past and current mining operations adjacent to and surrounding the Cyprus Miami mining operations. The mining district has been modified in form, line, color, and texture on a scale so significant in magnitude that it completely dominates the landscape and viewshed of the surrounding area for miles.

Three observation points have been identified through public and agency scoping meetings as key viewpoints for analysis on how the proposed project may impact the visual resource. These include (1) Top-of-the-World, (2) Along U.S. Highway 60/70 at the Oxhide pit gate, and (3) U.S. Highway 60/70 east of Arizona Highway 88. The key observation viewpoints are shown in **Figure 3-16** and views from them are presented in **Figures 3-17, 3-18, and 3-19**, respectively.

The Forest Service and BLM's visual analysis inventory processes are similar, yet differ in terminology and analysis. For consistency, the BLM agreed to use the Forest Service Visual Management System (VMS) guidelines (Forest Service 1974). The VMS uses three inventory components to develop Visual Quality Objectives (VQOs): (1) Variety Classes; (2) Sensitivity Analysis; and (3) Seen Areas or viewing distance. These define the acceptable level of alteration of the natural landscape by a proposed project or management action.

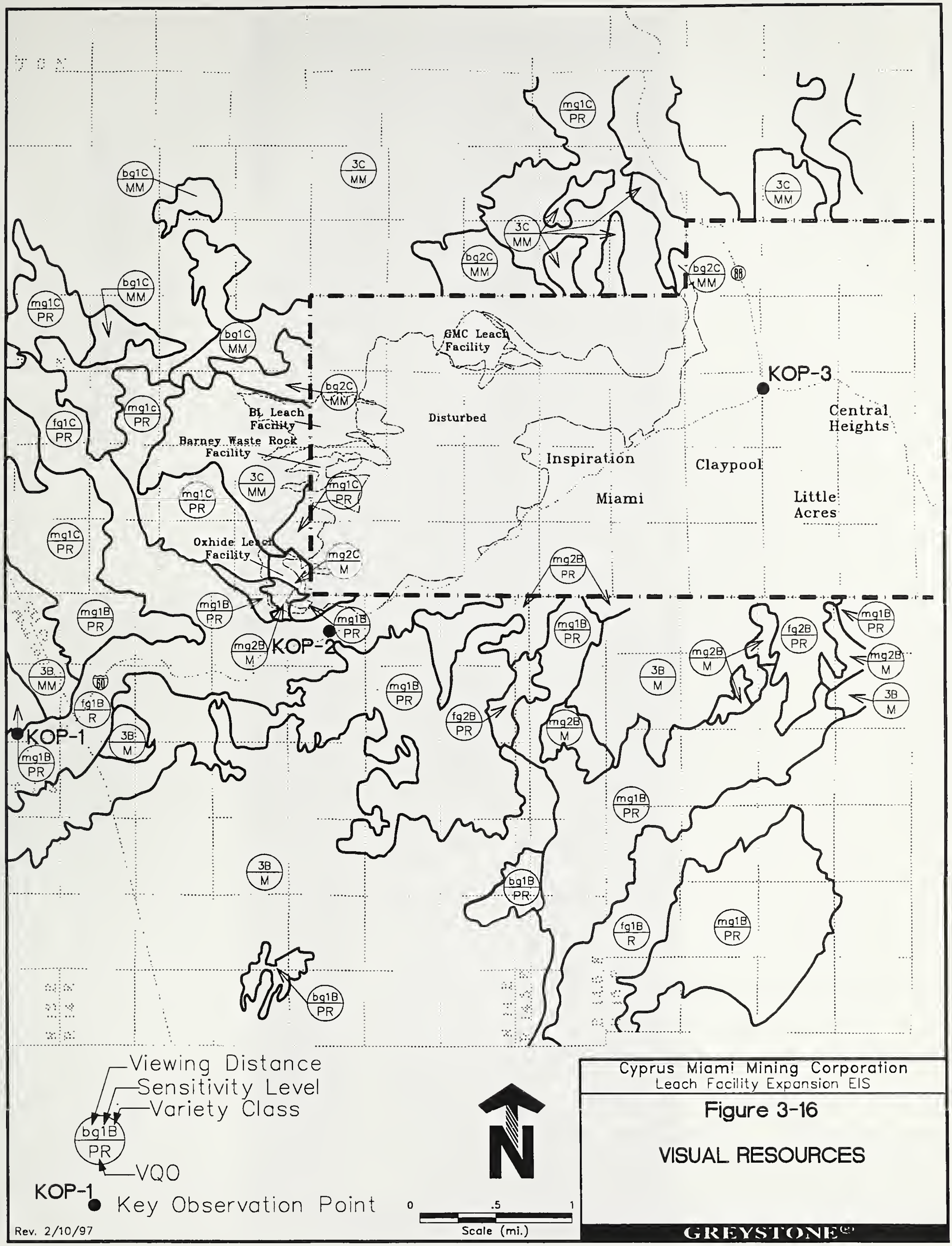


Figure 3-16

VISUAL RESOURCES

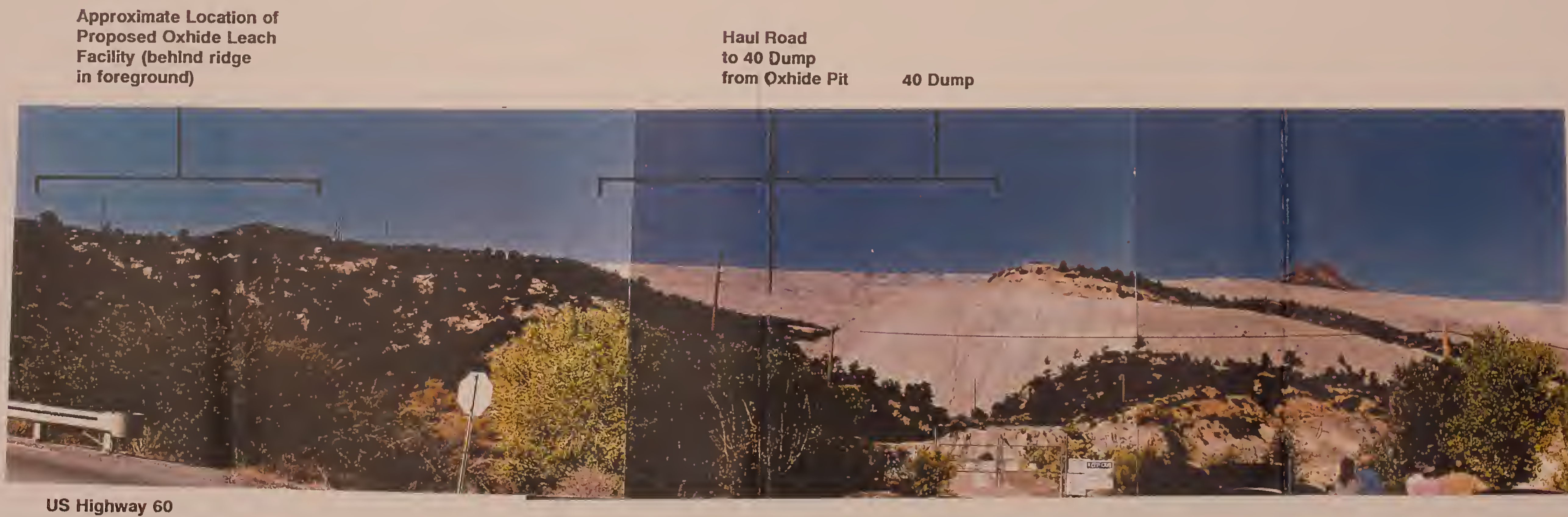
Cyprus Miami Mining Corporation
Leach Facility Expansion EIS

Figure 3-17

VIEW FROM TOP-OF-THE-WORLD
OBSERVATION POINT 1

GREYSTONE

UPDATED 2/10/97

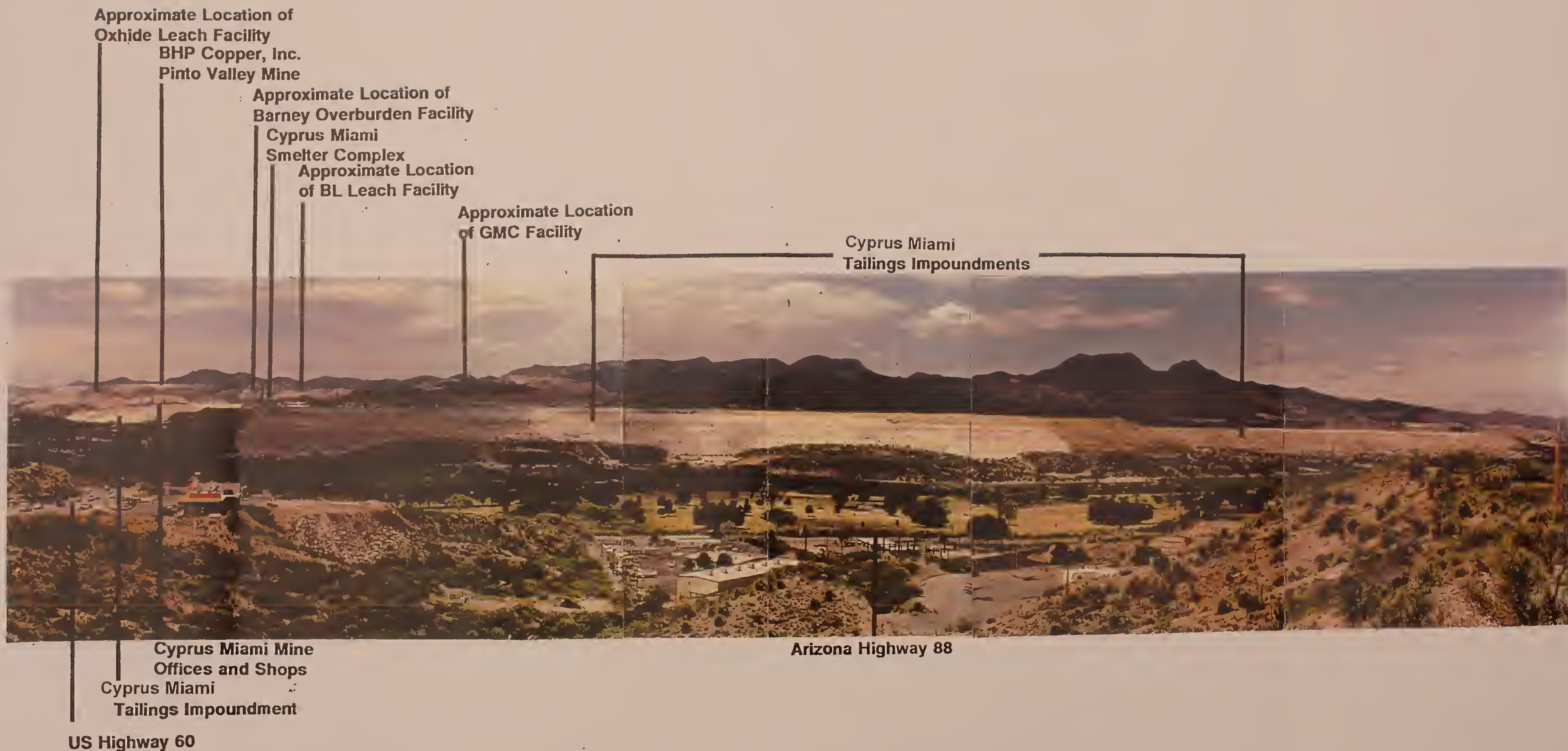


Cyprus Miami Mining Corporation
Leach Facility Expansion EIS

Figure 3-18

VIEWS FROM OXHIDE PIT GATE –
OBSERVATION POINT 2

GREYSTONE



Cyprus Miami Mining Corporation
Leach Facility Expansion EIS

Figure 3-19

VIEWS FROM U.S. HWY 60/70 AT ARIZONA HWY 88 - OBSERVATION POINT 3

GREYSTONE

3.9.2 Visual Management System

Three variety class designations describe a landscape's scenic importance: Class A - Extraordinary landscapes, Class B - Typical or common landscapes, and Class C - Undistinguished landscapes with little variety in line, form, color, or texture.

Sensitivity Level measures viewer interest in the landscape's scenic qualities . All land is seen, but each visitor has a different level of expectation of the visual environment. The sensitivity levels are: Level 1 - Highest Sensitivity, Level 2 - Average Sensitivity, and Level 3 - Lowest Sensitivity.

Seen Area, (viewing distance) has three categories: (1) Foreground - landscape seen from where the observer is viewing to ¼ to ½ mile, (2) Middleground - from the foreground to the background, ¼-½ to 3-5 miles, and (3) Background - from 3 to 5 miles to infinity. Visibility of the landscape is a function of many, interconnected considerations: context of viewers, duration of view, degree of discernible detail, seasonal variations, and number of viewers.

Variety Classes, Sensitivity Levels and Seen Areas are combined to determine the visual quality objective (VQOs). Four VQOs provide measurable standards for the visual resource management for this planning area.

(1) Retention (R) - management activities are not visually evident to the casual forest visitor.

(2) Partial Retention (PR) - man's activities may be evident, but must remain subordinate to the characteristic landscape.

(3) Modification (M) - man's activity may dominate the characteristic landscape, but must utilize naturally established form, line, color and texture.

(4) Marginally Acceptable (MA) - man's activity may dominate the characteristic landscape, but when viewed as background, should appear as a natural occurrence.

A fifth VQO, Preservation, which only allows for ecological changes, was not identified in this area. **Table 3-27** presents data on the VQO classifications in the project area.

Table 3-27. Existing VQOs on Forest Service Lands in Project Area

VQO	Globe Ranger District Portion of Management Area 2F		Forest Lands Within Two Miles of the BLM Boundary	
	Percent of Globe Ranger District	Acres	Percent of Adjacent Lands	Acres
Retention	8	30,868	12	3,480
Partial Retention	24	92,604	37	11,020
Modification	34	131,188	13	3,770
Marginally Acceptable	34	131,188	37	10,730
TOTAL	**100**	**385,858**	**100**	**29,000**

Source: USDA Forest Service 1985a.

The visual resources of the project area have been inventoried by the Forest Service (Wilson 1995). Data and mapping of the VQOs were collected from the Forest Service (VQOs are illustrated on **Figure 3-16**). No inventory has been compiled for Bureau of Land Management lands. The probable VQOs for BLM lands in the study area have been determined by extrapolating the VQOs of National Forest lands located in a two-mile width around the USFS/BLM boundary onto BLM lands. The percentage of each VQO was calculated for USFS lands. It was assumed that existing visual resources of BLM lands in the study area would have a similar percentage of VQOs.

3.10 HAZARDOUS MATERIALS

Operations at Cyprus Miami currently generate both hazardous and non-hazardous materials. The majority of the wastes generated are "mine wastes." These wastes are managed in a manner consistent with the Operating Plan and management practices which include stormwater run-on and run-off controls, monitor wells, and good management practices. Details of stormwater run-on and run-off practices are included in Cyprus Miami's Stormwater Pollution Prevention Plan which is part of their National Pollutant Discharge Elimination System (NPDES) Permit (AZR 004 A 421) which was approved in 1994 by ADEQ. Hazardous air emissions were discussed in Section 3.1.1 and are subject to Cyprus Miami's Class II operating permit application from ADEQ.

Currently, Cyprus Miami stores various materials that can be considered hazardous. The majority of these materials are petroleum hydrocarbons, such as gasoline, diesel, and oils. A summary of the locations, capacity, and products in each of the petroleum tanks is provided in

Table 3-28. The other hazardous material stored in large quantities at the facility is sulfuric acid. This material is stored in various facilities throughout the site and these facility locations and capacities are presented in **Table 3-29**. Sulfuric acid is corrosive and therefore may be designated as a corrosive (D002) waste (if the pH of the material is less than two). Sulfuric acid (H_2SO_4) is not a Resource Conservation and Recovery Act (RCRA) U listed (commercial chemical products, non-acutely hazardous), F listed (non-specific sources) or K listed (specific source) waste. The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requires reporting to the National Response Center (NRC) any release to the environment of this material in amounts greater than 1,000 pounds.

All of the acid tanks at the Cyprus Miami operation are located within drainages that are closed basins or drainages whose outfall is an impoundment. The two Ferric Cure tanks (Nos. 3 and 4) are located in a watershed (Watershed No. 6 on **Figure 3-8**) which drains into the BL Pit. The area surrounding the Oxide tank (Watershed No. 8) drains into the Upper Oxide pit. The four Acid Plant tanks are in an area that drains towards a containment known as Waldo's Pond. The New Refinery tank is located in an area that drains to a concrete sump in the refinery parking lot, which is pumped to the process pond. The four acid plant tanks and the New Refinery tank are located in Watershed No. 15, as is the Oxygen plant tank that is located in an area which drains west and south to a containment pond on the slag dump. None of these watersheds have sensitive receptors located downstream.

Other materials are currently stored at the facility in minor amounts. The materials (and their method of storage) are categorized as extractants for copper recovery (in barrels or bags), diluents to dilute and treat process solutions (in barrels or bags), laboratory chemicals (in bottles), ammonium and ammonium hydroxide for pH control (in bags or bins), and several miscellaneous items such as flocculents and adsorbents (in barrels or bags).

Storage facilities for both petroleum products and acid generally consist of above-ground storage tanks, and secondary containment structures surrounding the tanks. Transfer of acid to the leach pads is accomplished via above-ground piping. At each of the leach pads, solution is applied at various rates as a function of the total copper grade and the acid consumption of the particular mineral type. Leachate is collected from the toe of each pad via underdrain systems and collection ditches. All sulfuric acid utilized in this process is part of a closed circuit and no sulfuric acid is ever discharged.

Table 3-28. Summary of Petroleum Project Storage at Cyprus Miami Facilities

Materials	Number of Locations	Total Capacity (Gallons)	Capacity of Secondary Containment (Gallons)
Used Oil	7	45,300	68,751
Mineral Oil	46	23,208	33,682
Miscellaneous Oil	3	4,125	21,600
Diesel Fuel	12	155,241	357,980
Gasoline	7	46,600	603,000
Antifreeze	5	24,897	9,300
Solvent	1	40	0*
Hydraulic Oil	4	40,510	0*
Lube Oil/Grease	7	14,620	81,738
Regal Oil	1	6,431	7,400
Crater Grease	1	550	0*
Gear Lubricant	4	2,200	0*
Used Solvents	1	750	11,500
Used Antifreeze	1	840	11,500
Motor Oil			
10W	4	30,550	14,800
15W	2	3,100	2,000
40W	2	26,500	7,400
50W	2	1,650	0*
85W	2	20,000	0*
140W	1	6,548	3,590

*Inside buildings or partially in bermed tank farms.
Source: Cyprus Miami Mining Corporation

Table 3-29. Location and Capacity of Sulfuric Acid Storage Tanks

Tank Name	Location	Total Capacity in Gallons	Diameter in Feet	Height in Feet
Red Hill	Red Hill	341,000	44	30
Ferric Cure No. 3	Above SX Plant	1,350,000	237	40
Ferric Cure No. 4	Above SX Plant	1,350,000	237	40
Oxhide	Above 40 Dump	341,000	44	30
Refinery	New Refinery	6,000	10	12
Smelter No. 1	Acid Plant	341,000	44	40
Smelter No. 2	Acid Plant	341,000	44	30
Smelter No. 3	Acid Plant	341,000	44	40
Smelter No. 4	Acid Plant	341,000	44	30
Oxygen Plant Plant	Smelter	1,470	10	5
TOTAL		**4,753,470**		

Source: Cyprus Miami Mining Corporation

4.0 ENVIRONMENTAL CONSEQUENCES

This chapter describes potential environmental impacts that would result from construction, operation, and reclamation of the facilities associated with the proposed action and alternatives. Several resources were initially identified during the public scoping process as potentially being affected, but were later determined by the interdisciplinary team to not likely be affected. These issues include recreation, noise, wilderness and wild scenic rivers. These resources are not discussed in this chapter, but a brief description is provided in Section 3.0.1.

The impact analysis includes evaluation of all impacts resulting from the Proposed Action, Alternative A - Modified Development Sequence (Agency Preferred) and the No Action Alternative. The impact analysis also includes interrelated actions. The National Environmental Policy Act (NEPA) defines interrelated as an action that cannot occur independent of the Proposed Action. For the proposed leach facilities, the interrelated actions are the continued operation of the existing mine pits, and the solvent extraction and electrowinning plants. Therefore, impacts from these elements of the existing operations have been addressed along with the proposed project.

The impact analysis for each resource area begins with a statement of the issues that were raised during the scoping process and their evaluation criteria. These criteria are defined as threshold levels to indicate when a significant impact would occur. In some cases, regulatory standards are used, e.g., water quality and air quality standards. In other cases, more qualitative criteria are used as general indicators of significance based on professional judgement and agency guidelines.

Assessment of impact significance is made considering the effectiveness of specific design or reclamation measures of the Operating Plan described in Chapter 2. Residual impacts or unavoidable adverse impacts are identified which would remain after implementation. When significant or potentially significant impacts would remain after project design measures and best management practices have been applied, additional mitigation measures are proposed and are addressed under each resource discussion. These measures are recommended by the Forest Service and BLM and are not currently part of Cyprus Miami's Operating Plan. After the public review period is complete, the Forest Service and BLM will identify final mitigation measures in consultation with other agencies and the applicant and would require such measures as conditions or stipulations included in the final Plan of Operations.

Cumulative impacts are also addressed in each resource discussion in this chapter. These are defined as impacts that result from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions. Discussion of cumulative impacts for a given resource is included in the impact section for each resource. If there is no cumulative impact discussion, the reader can assume there are no cumulative impacts. The Forest Service and BLM have identified a variety of activities that have the potential to result in cumulative impacts with the Cyprus Miami Leach Facility Expansion Project. These include the categories of historic and active mining, proposed mining, and other activities listed below. The analysis area for each type of activity was dependent upon whether they had potential to add

cumulatively to impacts from the proposed action rather than if they were in a specific geographic location. These activities are summarized below.

Mining Activities

Cyprus Miami and the greater Globe-Miami community have over 130 years of mining history as one of America's dominant copper mining districts. The mining district was established in the 1870s, initially for silver and gold, but the transition to copper production was made by the 1880s. Of the numerous historic mines in the area, there are two which have impacted areas adjacent to the project area, four currently operating facilities, and one proposed mine. They are described in **Table 4-1**, which indicates 13,190 acres of current disturbance and 15,454 acreas of cumulative disturbance.

Table 4-1. Mining Activities in the Area

Operation	Operating Period	Owner	Disturbance
Continental	Early 1900s, now part of Pinto Valley Mine	BHP Copper, Inc.	Unknown
Globe Miami Copper Company Anchor Mine	1920s to 1950s	Cyprus Miami	Unknown
Cyprus Miami Miami Mine	Currently	Cyprus Miami	5,640 acres
	Proposed	Cyprus Miami	1,057 acres
Cyprus Smelter	Smelter only	Cyprus Miami	Included in above 5,640
Miami Unit (including Copper Cities/Mine)	Currently	BHP Copper, Inc.	4,230 acres
Pinto Valley Mine	Currently	BHP Copper, Inc.	3,320 acres
Carlota Copper Project	Proposed	Carlota Copper Company	1,207 acres
CUMULATIVE TOTAL			15,454 acres

Other Activities

Livestock grazing is conducted on three Forest Service livestock grazing allotments and one BLM livestock grazing allotment overlapping portions of the project area. There is potential for cumulative impacts on each of these allotments. Other activities in the region that could occur during the time period of the Proposed Action include highway construction or improvement, residential and commercial construction, power line construction, groundwater pumping, gravel

pit construction and others. Some of these activities might have cumulative effects with the leach facility expansion.

4.1 NO ACTION ALTERNATIVE

This section identifies the potential environmental consequences of implementing the No Action alternative. As identified in Chapter 2, under the No Action alternative, Cyprus Miami would continue mining for eight to ten years and recover copper for 10 to 20 years.

4.1.1 Air Resources

The issues raised about air quality during scoping or agency coordination included potential impacts from dust, acid drift, and odors to local communities and nearby Class I areas, as well as cumulative impacts. Several evaluation criteria were identified against which potential project emissions should be compared including:

- National Ambient Air Quality Standards (NAAQS).
- Arizona Ambient Air Quality Guidelines.
- Prevention of Significant Deterioration (PSD) Guidelines.
- Conformity with the Hayden area State Implementation Plan (SIP) and required Reasonably Available Control Measures/Reasonably Available Control Technologies.
- Potential effects on Air Quality Related Values (AQRV), including visibility.

This section identifies the potential air quality impacts associated with the Cyprus Miami expansion project. Air quality impacts are considered significant if ambient air concentrations exceed the levels of the National Ambient Air Quality Standards (NAAQS), the standards and guidelines, PSD Class I and Class II increments set forth by the State of Arizona. Furthermore, the proposed action and alternatives must conform with the rules and regulations of the Arizona State Implementation Plan.

Under the No Action Alternative, no BLM or Forest Service approvals would be needed and no additional federal lands would be utilized. No new leach pads or waste dumps would be constructed. The target production of 160 million pounds per year of electrowon copper would continue until the year 2000 with the placement of existing ore reserves onto existing leach pads until the existing pads have insufficient surface area to conduct an economical leaching operation (approximately 2007). Because the leach pads are nearly at capacity now, the No Action mining plan includes long haul truck traffic profiles, where loaded trucks travel the greatest distance to the existing leach pads and waste dumps.

4.1.1.1 Emissions

The Cyprus Miami mining process, described in Chapter 2, would result in the generation of fugitive dust from drilling and blasting in the mining pits, loading of ore and waste rock, trucks hauling ore and overburden, unloading at leach pads and waste rock dumps, light-duty vehicular traffic, and wind-blown generation of dust on exposed areas. Total fugitive dust emissions from

the Cyprus Miami mining operations are proportional to the amount of ore and waste rock mined, i.e., the mining process rate, and vehicular mileage transporting ore and waste rock to the leach pads and waste rock dumps.

4.1.1.1.1 Fugitive PM_{10}

The fugitive dust emissions from 1995 operations are described in Chapter 3. Under the No Action Alternative, Cyprus Miami would expect to maintain an annual mining rate near the 1996 rate of 104 million tons of ore and waste rock. Production would decrease slightly in 1998 and 1999 to a level of 96.0 million tons in 2000. The maximum PM_{10} emissions of 3,777 tons per year would occur in 2000. The largest source of PM_{10} is haul trucks. A conservative level of 70 percent control of PM_{10} emissions is assumed by use of water and dust supressants (100 percent control would mean no emissions would leave the site).

Table 4-2 shows the maximum annual PM_{10} emissions for the No Action, Proposed Action, Alternative A, and the portion of the emissions associated with Alternative A that would occur on federal lands. The emissions calculations and methodology for each mining process are described in the Evaluation for Conformity Analysis document, which is on file at the Tonto National Forest and the BLM Phoenix Field Office. The No Action emissions are used later in this chapter to compare the impacts of the Proposed Action and Alternative A.

Table 4-2. Comparison of Maximum Annual PM_{10} Emissions (Tons per Year)

Activity	No Action (Year 2000)	Proposed Action (Year 2005)	Alternative A (Agency Preferred) (Year 2007)	Alternative A Emissions from Expansion Footprints* (Year 2007)
Blast Hole Drilling	2.40	2.28	2.22	3.08
Blasting	71.01	67.45	65.62	0.00
Loading and Dumping	27.16	25.80	24.86	3.08
Haul Truck Travel	3299.95	3914.06	3188.22	191.57
Light Truck Travel	79.96	79.96	76.65	4.80
Wind Erosion	63.24	60.08	58.39	14.47
Dozer Activity	13.11	12.45	7.47	4.80
Diesel Fuel Combustion	220.88	277.74	213.47	12.82
Total	3777.71	4439.82	3636.90	228.36
Net (Compared to No Action)	NA	+662.11	-140.81	NA

Source: Evaluation for Conformity Analysis.
* Expansion footprints are the new facility sites that would disturb federal and private lands.

4.1.1.1.2 Nitrogen Oxide and Sulfur Dioxide Emissions

NO_x and SO_2 emissions would result from diesel fuel combustion (primarily from haul trucks) and the detonation of ammonium nitrate used in blasting activities. Additional SO_2 emissions could result from the burning of fuel oil for the EW Tankhouse boiler if, in an emergency situation, the boiler was converted from natural gas to fuel oil. Similar to reasons previously described for the maximum fugitive PM_{10} emissions in the year 2000, the maximum diesel fuel combustion and blasting activities would also occur in the year 2000. **Table 4-3** shows the maximum annual NO_x and SO_2 emissions for the No Action, Proposed Action, Alternative A, and the portion of the emissions associated with Alternative A that would occur on just the new disturbance areas. The No Action emissions are used later in this chapter to compare the impacts of the Proposed Action and Alternative A.

Table 4-3. Comparison of Maximum Annual NO_x and SO_2 Emissions (Tons per Year)

Pollutant	Activity	No Action (Year 2000)	Proposed Action (Year 2005)	Alternative A (Agency Preferred) (Year 2007)	Alternative A Emissions from Expansion Footprints* (Year 2007)
NO_x	Blasting	92.75	88.11	47.06	0.00
	Diesel Fuel Combustion	3324.30	4180.00	3217.09	193.31
Total		3417.05	4268.11	3264.15	193.31
Net (Compared to No Action)		NA	+851.06	-152.90	NA
SO_2	Blasting	10.91	10.37	5.55	
	Diesel Fuel Combustion	231.93	291.63	224.07	13.46
Total		242.84	302.00	229.62	13.46
Net (Compared to No Action)		NA	+59.16	-13.22	NA

Source: Evaluation for Conformity Analysis.
* Expansion Footprints are the new facility sites that would disturb federal and private lands.

4.1.1.1.3 Volatile Organic Compound (VOC) and Hazardous Air Pollutants Emissions (HAPs)

Volatile organic compounds (VOCs) and hazardous air pollutant (HAPs) emissions were calculated for the existing Cyprus Miami mining operation for the State of Arizona Class II operating permit. VOC and HAPs emissions would occur from the Solvent Extraction (SX) and the electrowinning tankhouse (EW) facilities, and from the diesel fuel and gasoline tanks used to store fuel on the site. The mining rate would remain essentially constant, peaking in 2000. Therefore, these VOC and HAPs emissions would not increase over the present levels shown on **Table 3-5b**.

However, VOC emissions from fuel storage tanks would be proportional to the amount of fuel used throughout a year. VOC emissions in 1993 were calculated using the EPA approved TANKS2 computer program. The annual light-duty vehicle miles were estimated as 2.2 million miles per year. Since 1993, the light-duty fleet has been significantly reduced. As a result, the maximum annual mileage would be approximately one millon miles per year. With less gasoline needed to sustain a smaller fleet, VOC and HAPs emissions from gasoline storage tanks would decrease from the 1993 levels of 12.81 and 0.33 tons per year, respectively (see **Tables 3-5b and 3-6**). However, small VOC emissions from diesel storage tanks would increase slightly. No HAPs emissions occur from diesel fuel storage. The maximum amount of annual diesel fuel usage for the No Action Alternative would be 14.0 million gallons. Diesel fuel consumption in 1993 was 7,995,750 gallons and VOC emissions from the storage tanks were 0.07 tons per year. Scaling up these 1993 emissions to the maximum emissions in 2000 yields 0.12 tons per year [(14,000,000/7,995,750) x 0.07].

4.1.1.2 Mitigation Measures and Monitoring

Cyprus Miami employs standard operating procedures to reduce dust emissions from unpaved roadways and facilities within the Cyprus Miami mining areas. Cyprus Miami complies with Arizona regulations pertaining to fugitive dust including: material handling (AAC R18-2-606); opacity (AAC R18-2-610); storage piles (AAC R18-2-607); and open areas, dry washes, and riverbeds (AAC R18-2-604). The specific procedures used at Cyprus Miami are provided below:

- Many of the main routes to offices, the main warehouse, the engineering buildings, etc. are paved. Vendors and administrative or support employees often do not need to drive on unpaved areas.

- Unneeded roads are closed, or access may be temporarily denied.

- Haul road widths are generally managed so that two passes of the water truck effectively treat the entire road surface. Haul roads are maintained to minimize surface area within safe operating parameters.

- Magnesium chloride is applied to secondary roads (access roads and pick-up roads other than the main haulage routes) seasonally as needed. Use of water trucks is then optimized for dust abatement on the main haulage routes. Secondary roads are also watered, as needed.

- Main haulage routes are watered as needed. The equipment for watering includes three trucks with a capacity of 18,000 gallons each, and one truck with a capacity of 23,000 gallons. Water trucks and haul trucks are maintained to provide comparable availability. Active haul roads are watered at a rate of 0.4 liter per square meter. The typical situation during daytime hours under dry conditions is that roads are watered every two to four hours.

- Magnesium chloride is applied to some haulage routes depending on conditions, but not within 300 feet of a leach pad.

- Water trucks are radio dispatched to areas where water is needed.

- Three strategically located loading points are positioned around the property to minimize the distance that water trucks must travel while empty.

- Tailings facilities are reclaimed, are under current reclamation, or are used to store water, thus eliminating a potential source of wind blown dust.

- Cyprus Miami employees are trained to operate vehicles responsibly, at or below posted speed limits to minimize dust production. Loaded vehicles travel very slowly and empty vehicles are speed-governed to a maximum speed of approximately 35 miles per hour.

The above-listed procedures are currently in use at Cyprus Miami and will be used during planned future operations including the development and operation of the proposed leach facilities and overburden facility (BL, GMC, Oxhide, and Barney).

4.1.2 Geology and Minerals

The effects of the No Action Alternative would be reductions in both the rate of production and the total copper recovered from the district's mineral resources. The average rate of copper production would be reduced from around 160 to around 55 million pounds per year. The total copper recovered from the reserves would be reduced from about 2.8 to 1.0 billion pounds.

The geologic terrain of all four proposed sites would remain undisturbed, with no changes in topography. An additional 151 acres would be disturbed at existing leach pads and waste rock dumps. Without the placement of ore or overburden, at new locations, slope stability would not be an issue. Although the probability of locating economically viable mineral reserves appears

low, adopting the No Action alternative would allow for additional geologic exploration at the four sites.

4.1.2.1 Cumulative Effects

Cumulative effects under the No Action alternative would involve additional mining disturbance of 151 acres, which, when added to the existing mining disturbance in the area, would cumulatively total 13,340 acres (**Table 4-1**).

4.1.3 Water Resources - Groundwater

No additional impacts to groundwater quality or quantity would be expected under the No Action alternative.

4.1.4 Water Resources - Surface Water

Under the No Action alternative, the surface water resource would be maintained in its current status. No additional impacts are anticipated.

4.1.5 Soils

Under the No Action alternative, there would be only minor new disturbances of soils within the study area other than those already approved under the current Operating Plan. A total of 151 acres of the study area would be disturbed under the current Operating Plan (**Table 2-4**). Sediment production would continue at existing rates at the four facility sites.

4.1.5.1 Cumulative Effects

The cumulative effect of the No Action alternative would be soil disturbance of 13,340 acres in the Miami mining area, an increase of 151 acres.

4.1.6 Biological Resources

4.1.6.1 Vegetation

Under the No Action alternative, no direct or indirect effects to general vegetation or threatened, endangered, candidate, or sensitive species of plants are expected beyond those occurring under existing operations. An additional 151 acres, primarily oak chaparral, would be disturbed.

4.1.6.1.1 Cumulative Effects

An additional 151 acres would be disturbed under No Action, primarily in the oak/chaparral community. The cumulative effect would be 13,340 acres of disturbance in the Miami mining area.

4.1.6.2 Wildlife and Special Status Species

Minor amounts of land disturbance would continue within Cyprus' private lands. However, there would be no disturbance of public lands. Therefore, selection of the No Action alternative would result in no additional impacts to wildlife beyond those already occurring. Upon closure of the site and after reclamation, all disturbed and reclaimed habitats within the project area would be available for reinvasion by wildlife.

4.1.6.2.1 Cumulative Effects

The loss of 151 acres of habitat would have a negligible effect on wildlife. The cumulative effect would be 13,340 acres of disturbance on the Miami mining area.

4.1.7 Cultural Resources

Under the No Action alternative, mining activity would continue within the currently permitted areas. Under this alternative, there are no potentially significant cultural resource sites identified within the areas of proposed disturbance. None of the identified cultural resources would be directly impacted by this alternative. However, present processes of site deterioration would continue at the current rate due to natural processes and unrestricted human activity. Cyprus Miami would disturb an additional 151 acres in the process of completion of mining and leaching within the permitted areas. The disturbance would occur largely on patented lands. None of the cultural resources identified would be affected by continued operations.

4.1.8 Socioeconomics

4.1.8.1 Population and Housing

Under the No Action alternative, Cyprus Miami would continue mining and placing ore but at a decreasing rate until approximately 2007. At that time, mining would cease and reductions in mining personnel would begin. Job losses could be as large as 309 workers. Those workers and families (assuming 2.3 persons per family) could represent a population of over 740 persons. Some unknown number of the laid-off workers and their families would likely move to other communities in search of work. If some of the workers in the 540 secondary jobs supported by the mining employees also experienced layoffs, a population reduction in the area would be anticipated. However, if all the laid-off mining personnel moved out of the community, it would represent less than 0.3 percent of the population, or if all jobs were lost (309 + 540) and all

those persons and families left the community, it could mean over 2,000 would leave, or approximately 0.8 percent of the population.

4.1.8.2 Environmental Justice

Implementing the No Action alternative would result in no changes for the first year. Subsequently, as layoffs began (approximately 30 people per year over 10 years) Hispanic workers would be disproportionately affected. This is because Hispanic workers comprise a disproportionate share of the Cyprus Miami work force. Cyprus's workforce is approximately 50 percent White (non-Hispanic), 43 percent Hispanic, and 5 percent American Indian. The area population is approximately 76 percent White (non-Hispanic) and 18 percent Hispanic. The unemployment rate for Hispanics would be expected to rise greater than the rate of rise for White (non-Hispanic) workers.

4.1.8.3 Employment and Personal Income

Without the expanded leach facilities, it is expected that employment at the Miami operations would drop to 559 by 2007. That represents a net difference of 309 mine and leach pad facility workers who would lose their jobs as a direct result of the No Action alternative.

The layoff of 309 Cyprus Miami workers envisioned if the proposed expansion does not take place would change the unemployment rate in Gila County from 7.3 percent (1994) to 10.1 percent. The percentage of persons of Hispanic origin among Gila County's unemployed would increase from 22 percent (in 1993) to 30 percent. The share of the unemployed accounted for by White-non-Hispanics would drop from 57 percent to 54 percent as a direct result of such layoffs. The proportion of American Indians among the county's unemployed would go from 15 percent to 10 percent as a direct result of such layoffs, although the number of unemployed American Indians would increase in absolute terms. The analysis for Indian unemployment is for Gila County exclusive of the reservation, and is explained in **Table 4-4**.

Table 4-4. Changes in Percent Unemployed by Race Under No Action Alternative

	Total	White/ Non-Hispanic	Hispanic	Indian	Other
Number of Unemployed in Gila County - 1994	362	127	79	53	103
Percent of Unemployed Persons	100	35.1	21.8	14.6	28.4
No Action Alternative - 309 Layoffs (170 White/Non-Hispanic, 124 Hispanic, 15 Indian	671	297	203	68	103
Percent of Unemployed Persons	100	44.3	30.2	10.1	15.3

The direct loss of 309 jobs in the Globe-Miami area labor markets would result in a drop in total employment in those labor markets by about 5% of the average for 1994 of about 6,100 jobs. The combined unemployment rate for those labor markets would be expected to rise from the 5.6% average of 1994 to 10.6% in 1997. This assumes no other change in labor market conditions between 1994 and 1997, and does not take into account the jobs that are indirectly dependent upon the Cyprus Miami operations.

No Action would mean total site closure by 2017, of the mine, copper recovery, and copper manufacturing. The loss of a total of about 950 jobs at closure would directly and indirectly affect the labor markets of the Globe-Miami part of Gila County. The accumulated loss of 950 jobs in the Globe-Miami area labor markets would likely result in an increase in the unemployment rate of 13 points, from 5.6 percent in 1994 to nearly 19 percent by 2018 if the No Action alternative were implemented.

Under No Action, total annual wages and salaries would start decreasing from $13,632,000 in 1998 and decrease to essentially zero by 2018. This would represent a 4-percent loss in total personal income in Gila County. The purchase of goods and services would decrease from $40,698,000 to essentially zero by 2018. Of this amount, $17,317,000 would be lost to suppliers located in Gila County annually. There would be no change in costs or benefits to permittees grazing livestock on allotments in the study area.

Some of the State and local taxes paid directly by Cyprus Miami would continue to be paid at current rates under the No Action alternative. However, severance taxes would decrease from the current level of $1,380,000 annually to zero at mine closure in 2007. Property taxes would continue at similar levels, but $940,000 in sales and use taxes would decrease, $380,000 in payroll taxes would decrease, and $275,000 in other taxes and fees would decrease to zero over a 10- to 20-year period.

Indirect effects on local business firms would include a decrease over time in the $23 million in sales attributed to the presence of the Cyprus Miami facility in the community.

Local governments in Gila County would continue to receive tax payments based on property taxes. If the layoffs of mine workers contributed to any out-migration of population, then personal property taxes paid in Gila County would decrease somewhat. The school district would experience reduced property tax revenues.

Incorporated municipalities outside Gila County would experience annual decreased tax revenues from the $320,000 they currently receive through apportionment of decreased severance and sales taxes. Various school districts would also see decreases from the more than $1.0 million they currently receive. Other county governments would experience decreases from the $490,000 they currently receive in apportionments. The State of Arizona would also experience decreased tax revenue from the $1.1 million it currently receives from Cyprus Miami.

In summary, the economy of Gila County would experience annual losses over a 10- to 20-year period of direct benefits of $34,119,000 and indirect benefits of $33,784,000. The State of Arizona would also experience economic losses of direct benefits of $60,384,000 and indirect benefits of $181,787,000. For the total 10 to 20 year decline under No Action, losses would amount to $67.9 million for Gila County and approximately $2.4 billion for the State of Arizona.

4.1.8.4 Education

If the loss of 309 jobs resulted in any population reduction in the area, the school districts might experience a slight reduction in number of school children. However, tax revenues to the school districts from Cyprus Miami would also be reduced under the No Action alternative.

4.1.8.5 Public Safety

If the loss of 309 jobs resulted in any population reduction in the area, there might be a slight reduction in demand for public safety and other local government services. However, tax revenues to local governments to support these services would also be reduced.

4.1.8.6 Health Care and Other Service Sectors

If the loss of 309 jobs resulted in any population decrease, then the demand for health care services might experience a slight reduction. However, the funding for non-governmental service providers is largely based on user-fees, so funding would be expected to match any changes in demand.

4.1.8.7 Tax Base

In Gila County, the No Action alternative would result in a loss over a 10- to 20-year period in annual salaries and wages of $13,632,000, and annual losses of local purchases of $17,317,000. Property taxes would remain at a similar level as current taxes. In Arizona, the No Action alternative would result in a loss of $14 million in personal income, $40.7 million in sales for Arizona businesses, and nearly $6.1 million in state and local government revenues each year. Local governments would also experience losses in indirect benefits resulting from the circulation and recirculation of Cyprus Miami payments which would amount to $1.7 million each year. Cumulative direct and indirect losses to Governmental units in Gila County would be approximately $4.9 million per year. The total cumulative loss to the State of Arizona of direct and indirect revenues would amount to $14.9 million per year.

4.1.8.8 Cumulative Effects

The cumulative effects from No Action are anticipated to be similar to the direct effects of the No Action alternative. This is based on the assumption that all other segments of the economy would remain at current levels of activity and only Cyprus Miami would experience the need to cease mining and reduce staff. However, there would be indirect effects contributing to an

economic downturn since Cyprus Miami directly contributes approximately four percent of the Globe-Miami economy.

However, it is recognized that there is potential for indirect cumulative effects on employment in the Globe-Miami area. This document indicates the 309 employees of the Cyprus Miami mine indirectly support 540 other jobs in the area. If the 309 jobs are lost, after a period of time, many, if not all, of the 540 indirect jobs might be lost as well. The 849 total jobs could represent a population of over 2,000 people in the area that could be affected.

It is also possible that if the No Action alternative was implemented at the Cyprus Miami mine, some of the direct losses of employees and purchases and taxes might be offset by new operations at the Carlota Mine which is planned for development in the future. There could be a shift in employment to the new operation that might contribute wages and taxes similar to those lost if Cyprus Miami reduced operations. However, the timing of operations at Carlota is not currently known so even if Carlota might offset the No Action alternative at Cyprus Miami, there might be a time period where job dislocations would still occur.

4.1.8.9 Mitigation Measures and Monitoring

No mitigation or monitoring would be proposed under the No Action alternative.

4.1.9 Land Use

4.1.9.1 Land Use Plans

No impacts to existing land uses such as recreation, grazing, wildlife habitat, current mining uses, or transportation would occur under this alternative. The existing condition of Forest Service and BLM lands in the project area would be maintained under the current management direction as defined in the Tonto National Forest Land and Resource Management Plan and the BLM Resource Management Plan.

4.1.9.2 Mining

It is expected that the existing mining operations of Cyprus Miami would continue for the current mine life of eight to ten years. Ore placement would continue at five leach facilities and waste rock would be deposited at seven facilities. Activities would disturb an additional 151 acres.

4.1.9.3 Livestock Grazing

The No Action alternative would not have any effects on existing grazing operations.

4.1.9.4 Public Access

Existing mining operations have resulted in restricted access to public lands in the vicinity of mine facilities for public safety. Under the No Action alternative the existing mine area closed to public access would remain closed until final reclamation of the existing mine operations is completed and existing public access restrictions are lifted.

4.1.9.5 Transportation

Overall transportation effects associated with the selection of the No Action alternative would involve a gradual reduction in mine generated traffic starting in 1997 as a result of the decline in mine operations and its eventual closure. Overall, closure of the mine would result in an improvement to existing traffic conditions in the Globe-Miami area, as gradual decreases would occur in traffic trips by employees, product transport, and associated commercial deliveries. This could result in an overall improvement of roadway levels of service. The No Action alternative would have no effect on Forest Service road management or the Resource Access Travel Management Plan.

4.1.9.6 Cumulative Effects

Cumulative effects under No Action would be limited to disturbance of 151 acres, bringing total Cyprus Miami disturbance to 5,790 acres, and disturbance in the adjacent mining area to 13,340 acres.

4.1.9.7 Mitigation Measures and Monitoring

No mitigation or monitoring would be necessary for the No Action alternative.

4.1.10 Visual Resources

No impacts to the existing visual resource on public or private lands would occur under this alternative. The existing condition of Forest Service and BLM lands in the project area would be maintained under the current management direction as defined in the Tonto National Forest Land and Resource Management Plan and the BLM Resource Management Plan. It is expected that the existing mining operations of Cyprus Miami would continue for 8 to 10 years. There would be no change in the visibility of existing project facilities, as no additional road closures would occur.

4.1.10.1 Cumulative Effects

The No Action alternative would disturb an additional 151 acres and contribute to a cumulative effect of 13,340 acres disturbed by mining in the area. Cumulative visual effects would generally remain unchanged.

4.1.10.2 Mitigation Measures and Monitoring

Once mining operations have ceased at any specific facility, level and gently sloping areas would be reclaimed and vegetation would be re-established. The post-mining topography would match the surrounding natural terrain.

4.1.11 Hazardous Materials

Present operations would continue at the mine and processing facilities. Cyprus Miami operations would have 2,500 fewer tons of sulfuric acid on site than the Proposed Action and, thus, have approximately 0.05-percent lower chance of an accidental spill, but this is a negligible change.

4.1.11.1 Cumulative Effects

Cumulative effects under No Action would be representative of current conditions.

4.1.11.2 Mitigation Measures and Monitoring

No mitigation or monitoring would be proposed under the No Action alternative.

4.2 PROPOSED ACTION

This section identifies the potential environmental consequences of implementing the Cyprus Miami proposed Plan of Operations. Impacts are evaluated on an assumed project life of 16 to 20 years, followed by one or more years for reclamation.

4.2.1 Air Resources

The Proposed Action would be a continuation and expansion of the existing operations. The new leach pads would allow production levels to remain at a target production rate of about 160 million pounds of electrowon copper per year. The BL leach pad and the Barney waste rock deposition area would be constructed in 1997, the Oxhide pad by 2000, the GMC pad by 2004. This alternative is not the preferred choice by the land management agencies. If this alternative was selected, additional conformity and Air Quality Related Values (AQRV) analyses would be required prior to implementation. These studies are not being conducted at this time. Since Alternative A has demonstrated a net reduction in emissions, the agencies have selected it as their Preferred Alternative and the Proposed Action is not anticipated to be selected for implementation.

4.2.1.1 Emissions

4.2.1.1.1 *Fugitive PM_{10}*

Under the Proposed Action, Cyprus Miami would expect to maintain the mining rate near the 1995 mining rate of 95.7 million tons of ore and waste rock during 1996 and 1997. Production would decrease slightly in 1998 and 1999, then peak at 96.0 million tons in 2000 when construction of the Oxhide leach pad is completed. Then, a relatively constant production rate of 91.2 million tons per year would be maintained until the end of the mine plan in 2011. Although the annual mining rate would be at a maximum in 2000, the maximum annual emissions would occur in the year 2005 because of the long haul road distances associated with the commencement of waste rock hauling to the Barney waste rock facility. The projected maximum PM_{10} emissions of 4,439 tons per year in 2005 are based on analyses using a 70 percent control factor for haul road emissions.

The maximum PM_{10} emissions in 2005 would result in a net increase of 662 tons per year over the maximum emissions year of the No Action Alternative. Therefore, the air quality impacts of the Proposed Action would exceed the impacts of the No Action Alternative by more than 100 tons per year. As a result, Cyprus Miami has decided not to pursue the Proposed Action Alternative because it appears that the Proposed Action would have a greater effect on the air quality of the area. This alternative could not be implemented without a full Conformity analysis.

4.2.1.1.2 *Nitrogen Oxide Emissions*

NO_x emissions from diesel combustion and blasting activities would be 851 tons per year higher than the No Action Alternative, largely because of longer haul distances for trucks.

4.2.1.1.3 *Sulfur Dioxide Emissions*

SO_2 emissions from diesel fuel combustion and blasting activities would be 59 tons per year higher than the No Action Alternative, largely because of longer haul distances. The SO_2 emissions from emergency operations of a boiler if power is interrupted would be the same as under the No Action Alternative, because of a federally enforceable provision already included in the State Operating Permit.

4.2.1.1.4 *Volatile Organic Compound (VOC) and Hazardous Air Pollutant Emissions (HAPS)*

Hazardous air pollutant emissions result from the venting of vapors from fuel storage tanks and the use of methylene chloride as a cleaning agent at the tank house. The quantity of emissions 3.3 tons per year, was estimated from the fuel usage required to sustain the 1995 mining rate of 94.7 million tons. The source of the 3.3 tons per year would be the existing fuel storage tanks. The maximum mining rate expected during the expansion period, 96 million tons per

year, would result in a slight increase (1.4 percent) of HAPs to 3.35 tons per year. However, this slight increase would still be well under the aggregate HAP limit of 25 tons per year, or 10 tons per year for any single HAP.

VOC emissions would be identical to the No Action Alternative with one exception: the small VOC emissions from diesel storage tanks would be slightly higher. The maximum amount of annual diesel fuel usage for the Proposed Action Alternative would be 17.4 million gallons. Diesel fuel consumption in 1993 was 7,995,750 gallons and VOC emissions from the storage tanks were 0.07 tons per year. Scaling up these 1993 emissions to the maximum emissions in 2000 yields 0.15 tons per year [(17,400,000/7,995,750) x 0.07].

4.2.1.1.5 Sulfuric Acid Mist Emissions

Sulfuric acid mist emissions may be generated when a sulfuric acid solution is sprinkled over the leach pads. The weak solution, 9.4 grams sulfuric acid per liter of water, would be distributed through "wobblers" at rates from 0.0030 to 0.0047 gallons per minute per square foot (gpm/ft^2). The wobblers are designed to distribute the solution in an approximate 50-foot diameter with droplet sizes of three to six millimeters. This droplet size and rate of application is sufficient to minimize misting, wind drift, and evaporative losses. Although the magnitude of emissions is unknown, vegetation surveys around the existing leach pads (Bamberg 1996) have not shown acid stress on the adjacent vegetation. The expansion operations would retain the same application procedures as are currently used at Cyprus Miami, but would be applied over slightly larger areas at different locations. Based on the manufacturer's specifications for the application wobblers and the lack of acid stress on vegetation around the existing leach pads, it is anticipated that the new leaching facilities would not cause additional air quality impacts from drifting acid mist. Sulfuric acid emissions from the SX-EW plants would remain consistent with the No Action Alternative and current operations.

4.2.1.2 Conformity Determination

In accordance with the Federal Conformity Rule (40 CFR 93), the Tonto National Forest and the Bureau of Land Management have reviewed the potential emissions associated with the proposed Cyprus Miami Project because the project is located within the Hayden/Miami nonattainment area for SO_2 and PM_{10}. First, an analysis must be made if the potential direct and indirect SO_2 or PM_{10} emissions exceed the 100 tons per year, de minimis level for conformity applicability. If the potential emissions exceed this 100 tons per year threshold, then a conformity determination must be conducted. This means that for this project, new emissions cannot exceed current emissions (3,777 tpy PM_{10}) by more than 100 tons per year (3,877 tpy PM_{10}). Demonstrations must prove that the action does not cause or contribute to any new violation of any air quality standard in the area.

Under the Proposed Action, PM_{10} emissions would exceed the de minimis level of 100 tons per year (see **Table 4-2**). A full conformity analysis would need to be conducted in order to determine whether this alternative would cause a violation of any air quality standard. That

conformity analysis would be completed if this alternative were selected for implementation. However, since Alternative A was selected as the Preferred Alternative because of a net decrease in emissions (an anticipated benefit), the conformity determination was judged not necessary.

4.2.1.3 Visibility Impacts to Superstition Wilderness

Federal land managers areas have the responsibility to protect the Air Quality Related Values (AQRV) of Class I airsheds. The Superstition Wilderness, located west of the project site, has been designated as a Class I area. Visibility has been designated as an AQRV for the Superstition Wilderness. Because PM_{10} and NO_x emissions can degrade visibility at locations away from the emissions sources, an analysis must be performed for a Federal action that may affect the visibility at the Class I area.

The emissions inventory presented in **Table 4-2** shows that maximum annual PM_{10} emissions under the Proposed Action would have a net increase of 662 tons per year. As a result, Cyprus Miami has decided not to pursue the Proposed Action Alternative and visibility impacts under this Alternative were not evaluated. If this alternative was selected, a visibility analysis would be conducted similar to that done for Alternative A.

4.2.1.4 Cumulative Effects

The PM_{10}, SO_2, and NO_x emissions would increase over those levels expected with the No Action Alternative as shown on **Tables 4-2 and 4-3**. Therefore, the Proposed Action Alternative would result in an unquantified cumulative effect on the regional air quality. If this alternative was selected, a cumulative analysis would be conducted of all regional sources.

4.2.1.5 Mitigation Measures and Monitoring

The existing monitoring stations described in Section 3.1.1.2 would continue to be operated during the life of the project. Mitigation measures described in Section 4.1.1.2 would continue. No further mitigation is proposed.

4.2.2 Geology and Minerals

The issues raised concerning geology and minerals included: 1) geotechnical considerations (the potential to create or worsen geologic hazards, as well as impacts to the project facilities from seismicity or existing geological hazards), 2) economic geology (the need to recover the economic minerals in an efficient manner, and the potential for impacts to future development of other mineral resources), and 3) geochemistry (potential to generate or neutralize acid).

4.2.2.1 Geotechnical Considerations

With the use of geomembrane liners at each of the three leach facilities, one of the most important design considerations is the steepness of the site terrain. Portions of each site are too steep for the safe placement of liner systems that involve geomembranes. These sites would require extensive site grading and infilling of the steeper relief with mine overburden, as shown in **Table 4-5**. Conceptual designs presented as part of the proposed action place all geomembrane liners on slopes at or less than 2.75H:1V, which is considered a properly engineered configuration with sufficient safety factors.

Table 4-5. Leach Facility Foundation Specifications

Site	Average Fill Thickness	Average Tons of Fill	Average Cubic Yards of Cut
Oxhide	40 feet	23 million	70,000
BL	80 feet	38.6 million	167,800
GMC	50 feet	18 million	326,000

How the fill material will be placed and its reaction to being heavily loaded by the leach pile are key factors in assuring site stability and operational integrity. Excessive differential settlement and consequent horizontal deformations of the overburden fill could cause damage to the synthetic liner. The potential for damage to the liner would partially depend upon the capacity of the fill to consolidate. The fill must also be of sufficient inherent strength to resist shearing forces that could cause slope failures in the ore or waste piles. These issues have been considered in the development of the final designs for the proposed action, (Golder Associates Inc. 1996a), safety factors are considered sufficient, and liner integrity is expected to be maintained.

Old underground workings might cave in and cause liner failure. To avoid this, the openings to old workings would be enlarged until a minimum of 10 feet of competent rock remained between the workings and the current ground surface above. The workings would then be backfilled to the surface and the fill compacted as much as practicable. This would ensure a stable base on which to build a foundation strong enough to support the liner and leach pad.

Seeps and springs under the pad could also serve as points of instability. To avoid this, drain pipes would be laid from the spring or seep area to connect with the underdrain system. In this manner, waters would be carried away and not be expected to saturate the foundation enough to cause instability. Similarly, the presence of other features such as landslide areas or clay-rich soils would be stabilized via best management practices and additional drainage pipes laid prior to being covered by foundation material. These efforts would mitigate any geological instability.

Internal stability of the leach and waste rock would depend on the sequence of material placement, the physical properties of the ore or waste, and the amount of saturation above the liner or foundation. Adequate designs call for the placement of the first lifts of ore or waste low in the topography, with subsequent lifts buttressed by preceding deposition. This process would further stabilize the leach pad system and prevent failure of the geomembrane. Maintaining low liquid pressures within the leach systems would be accomplished by the use of a permeable layer of screened ore and drainage pipe immediately above the liner. No excessive buildup of liquid pressure at the base of the Barney waste rock facility is anticipated, given the absence of process fluids and the semi-arid climate.

The analysis of site stability is an integrated effort including the combined influence of the foundation characteristics with the proposed components of facility design. This includes not only leach facilities, but embankment design for the BL impoundments and for solution collection reservoirs. The regulations for dam safety and for spillway design also had to be addressed. One analysis evaluates the risk of failure under static conditions, while another evaluates the effects of seismic shaking. These types of analyses have been completed for the facilities included in the proposed action and under both sets of conditions, sufficient factors of safety have been derived (Golder Associates, Inc. 1996a). These calculations indicate that the structures will resist the static and dynamic loads predicted without failure of the environmental control systems.

Documentation of the conceptual design of the proposed action (Golder Associates, Inc. 1995a) recognizes all the factors mentioned above that would influence stability of the facilities. Differential settlement and liner integrity issues have been addressed by considerable geotechnical testing and a detailed settlement model (Golder Associates Inc. 1996a). The settlement model developed for this study evaluated the entire footprint at the heap leach pads for settlement on a 50 ft. by 50 ft. rectangular grid, at approximately one-ft. depth intervals. The laboratory predicted settlement parameters were calibrated with the results of a 200,000 ton instrumented test fill. These analyses were used as the basis for the final design foundation grades, lift thicknesses and geomembrane specifications. The stability of the systems are further evaluated by the application of conventional analyses that include both static loading and the effects of earthquake ground motions (Golder Associates, Inc., 1996a).

4.2.2.2 Economic Geology

The issues associated with mineral resources include: covering areas containing potential mineral resources with waste rock dumps and heap leach pads and incomplete removal of mineral resources. Access to any mineral reserves under the facility disturbance areas by open-pit methods would not be possible. Exploration and condemnation drilling results have been used to locate overburden dumps in areas where ore deposits are absent or are not expected to be economically minable by conventional open pit mining methods.

The four facilities involved in the proposed action would be located over a variety of geologic rock units. None of these rock units are known as local sources of unique or valuable rock or mineral specimens. No significant or unique geomorphological features exist in the subject area.

No paleontological (fossil) resources are known to occur locally in the only sedimentary unit (Gila conglomerate) that would be affected by the proposed development.

4.2.2.3 Geochemistry

The potential for acid rock generation is largely a water quality issue and is discussed in section 4.2.3. A Materials Characterization Report was summarized in Chapter 3. That report indicated that copper-bearing ores of oxide schist, sulfide schist, granite porphyry and Schultze granite could generate acid, but that waste rock (dacite, Gila conglomerate, Schultze granite, and Pinal schist) had the potential to neutralize acid. The overall composition of the waste rock is predicted to have an acid neutralizing potential 15 times greater than the acid producing potential.

Given the anticipated use and placement of the tailings, the potential for acid generation, even though uncertain, is of little concern from an environmental perspective because the facility is designed so that tailings would not come in contact with water. The geomembrane liner on top and the foundation materials below would keep the tailings from coming in contact with the native ground surface. Impacts from potential leaks through the liner are described in Section 4.2.3.2.1.

The acid-base accounting information was used to prepare the Waste Rock Handling Plan (Golder Associates Inc. 1996d). The objectives of that plan are to specify the methods for identifying and handling potentially acid-generating waste rock. With implementation of the plan, the action alternatives would be expected to meet ADEQ water quality standards (Golder Associates Inc. 1995f).

4.2.2.4 Cumulative Effects

The cumulative effects of the proposed action upon the geologic and mineral resources of the area would be the additional removal of about 487 million tons of low-grade copper ore. This action would require disturbance of 1,057 acres of terrain adjacent to about 13,190 acres now disturbed by the active or past mining operations (**Table 4-1**). The use of these sites for the proposed operations would not collectively or individually interfere with future efforts to mine the mineral resources of the district. Under these conditions, no specific short-term or long-term cumulative effects other than those related to the acreage of surface disturbance, would be anticipated. The cumulative effects upon mineral resources include additional expansion or creation of additional open pits, underground workings, and waste rock dumps as ore reserves are removed.

4.2.2.5 Mitigation Measures and Monitoring

Monitoring of geotechnical aspects during construction and operation would be accomplished through implementation of the QA/QC program. At closure, final "as-built" surveys would be made of all dumps and pads not constructed to their previously approved configurations.

Stability analyses would be performed to confirm that these facilities meet acceptable stability criteria.

4.2.3 Water Resources - Groundwater

4.2.3.1 Groundwater Effects - Quantity

4.2.3.1.1 Leaching Facilities

The three proposed leaching facilities should not significantly affect groundwater flow or the depth to groundwater underneath and down-gradient of the leaching sites for the following reasons:

- Groundwater pumping near the leaching facilities will not occur, nor are there any plans for new water supply wells.

- Construction of the leaching facilities would be on top of the existing land surface - the underlying geology would be unchanged.

- Groundwater recharge areas up-gradient of the leaching facilities would not be altered.

4.2.3.1.2 Barney Waste Rock Site

The Barney waste rock site should not significantly affect the direction of groundwater flow or the depth to groundwater underneath the site for the same reasons listed above for the leaching facilities.

4.2.3.1.3 Mine Pits

As described in Section 3.3.1.2.1 of Chapter 3, groundwater flow and depths in the project area have been altered by a number of mining related activities, the most significant of which has been the creation of five mine pits.

The Proposed Action includes the following land surface alterations and groundwater effects:

- The BL Pit would be expanded to the west. The cone of depression surrounding the pit would expand to the west and may result in some groundwater drawdowns adjacent to the pit. There are no current or anticipated future groundwater uses in the area west of the BL pit that would be affected by expansion of the cone of depression.

- The BL pit would not be expanded to the south or east. Therefore, the existing cone of depression would not expand to the south or east and there would be no additional impact to groundwater flow or levels in those directions.

- The Lower Oxhide Pit would not be expanded. Therefore, the existing cone of depression surrounding this pit, which includes part of Bloody Tanks Wash, would not expand. There should be no further drawdown impacts to existing water users in the vicinity of Bloody Tanks Wash (Golder Associates, Inc. 1996b).

- The Upper Oxhide Pit has not been mined for several years, and there is no plan to resume mining at this location.

4.2.3.2 Groundwater Effects - Quality

4.2.3.2.1 Leaching Facilities

The three leaching facilities should have minimal impact on groundwater quality. This conclusion is based on five major factors, discussed below.

1) The engineering design of the leach facilities, as described in detail in the *Mining Plan of Operations (1996) and the Aquifer Protection Permit Application* (Golder Associates, Inc. 1996c), greatly reduces the potential for groundwater contamination.

- Each leach facility is designed as a closed-circuit system that meets or exceeds ADEQ's Best Available Demonstrated Control Technology (BADCT) criteria. The Leach Collection Recovery System (LCRS), which is an integral part of the closed-circuit system, is designed to prevent leachate solutions from reaching the environment. The bottom of each leach facility would be lined with a geomembrane liner; the solution collection ponds would be lined with two geomembrane liners. There would be 12 inches of fine-grained mill tailings beneath the geomembrane liner for cushioning. If leach solutions contacted the tailings through a breach in the liner, it is uncertain whether the leach solutions would be made more acidic. However, such potential leaks are not considered significant, as discussed in Section 4.2.2.3. An underdrain system beneath each leach facility would a) collect solutions that may pass through breaches in the synthetic liner, and b) collect groundwater inflows. All solutions collected by the underdrain system would report to the underdrain sumps. From the sumps, the solutions would be 1) pumped back to the leach pad, 2) pumped to holding ponds for evaporation or 3) discharged in accordance with State and Federal regulations. Removal of underdrain solutions has the additional benefit of eliminating excess pore pressures from building in the leach foundations. A leak collection and recovery system would exist underneath the solution collection pond.

- Groundwater quality monitoring wells would be located at optimal sites and depths down-gradient from each leach facility. These wells would be regularly monitored. Details concerning this monitoring, not yet finalized, would be contained in the Aquifer Protection Permit (APP) granted by the Arizona Department of Environmental Quality (ADEQ).

2) The local geology, described in detail in the *Groundwater Baseline Report* by Golder Associates Inc. *(1995e)*, should minimize impacts to groundwater.

- The low hydraulic conductivity of many of the rock units in the project area means that groundwater migrates slowly down-gradient of the heap leach facilities.

- The hydrologic connection between some of the rock units in the project area is minimal at many locations; this also slows the movement of groundwater down-gradient of the heap leach facilities.

- The Gila conglomerate, which is present in parts of the project area, has a demonstrated ability to neutralize acidic groundwater.

- Mine pits located down-gradient of the BL and Oxhide leach facilities will capture the majority of groundwater moving from beneath those leach facility footprints. As a result, most of the groundwater beneath the BL and Oxhide leach facilities will not leave the Project Area. A small, but unknown amount of groundwater underneath the Oxhide leach facility footprint may reach Bloody Tanks Wash.

3) Hydrologic modeling of groundwater quality and flow down-gradient of the leach facilities indicated minimal impacts. Such modeling was completed by Golder Associates, Inc. (1996b) as part of the Aquifer Protection Permit Application for the State of Arizona. The leakage prediction model used, developed by Bonaparte, et. al. (1989) and Van Zyl (1990), is a standard methodology used by the mining industry and the EPA. The major assumptions and conditions used for the Cyprus Miami project are listed below:

- The model is run for 36 years - 15 years of active leaching, 10 years of rinsing, 6 years of draining the heap leach pile, and 5 years for drainage of the unsaturated zone under the leach facility.

- The geomembrane liners contain one breach per acre. The median size of each breach is 0.4 $in.^2$

- The hydraulic head on top of the geomembrane liner never exceeds two feet.

- 70 percent of the seepage through the geomembrane liner reaches the aquifer and travels down-gradient; only 30 percent of the seepage is captured by the underdrain system.

- Hydraulic conductivity of the fine-grained soil layer underneath the geomembrane liner is 4.0×10^{-6} cm./s.

- Pollutant transport rates are modeled using chloride and sulfate; these parameters are highly mobile and non-reactive.

Using the above-listed assumptions, the major results as predicted from the model simulation are:

- The travel time for chloride to reach the water table is 38 years at the BL facility, 14 years at the Oxide facility, and 9.2 years at the GMC facility.

- The travel time for chloride to reach the nearest Point of Compliance (POC) groundwater monitoring well is 49-52 years at the BL facility, 53-59 years at the Oxide facility, and 39-45 years at the GMC facility.

- Cadmium will slightly exceed the Aquifer Water Quality Standard (AWQS) of 0.005 mg/l at the POC well down-gradient of the GMC facility. All of the other modeled constituents (nitrate, chromium, lead, nickel) will be less than the AWQS.

- The potential areal extent of pollutant migration (often termed the "Discharge Impact Area") extending down-gradient of the leach facilities was 1300 ft. for the BL facility and 1200 ft. for the GMC facility. The Discharge Impact Area (DIA) for the Oxide facility coincides with the down-gradient edge of the leach pad. These Discharge Impact Areas, depicted in **Figure 4-1**, are all contained well within the Project Area.

4) Groundwater quality underneath the three proposed leach facility sites is currently impacted as described in Chapter 3, Section 3.3.1.3.2. For the reasons described in items 1-3 above, it is unlikely that the proposed leach facilities would further degrade groundwater quality.

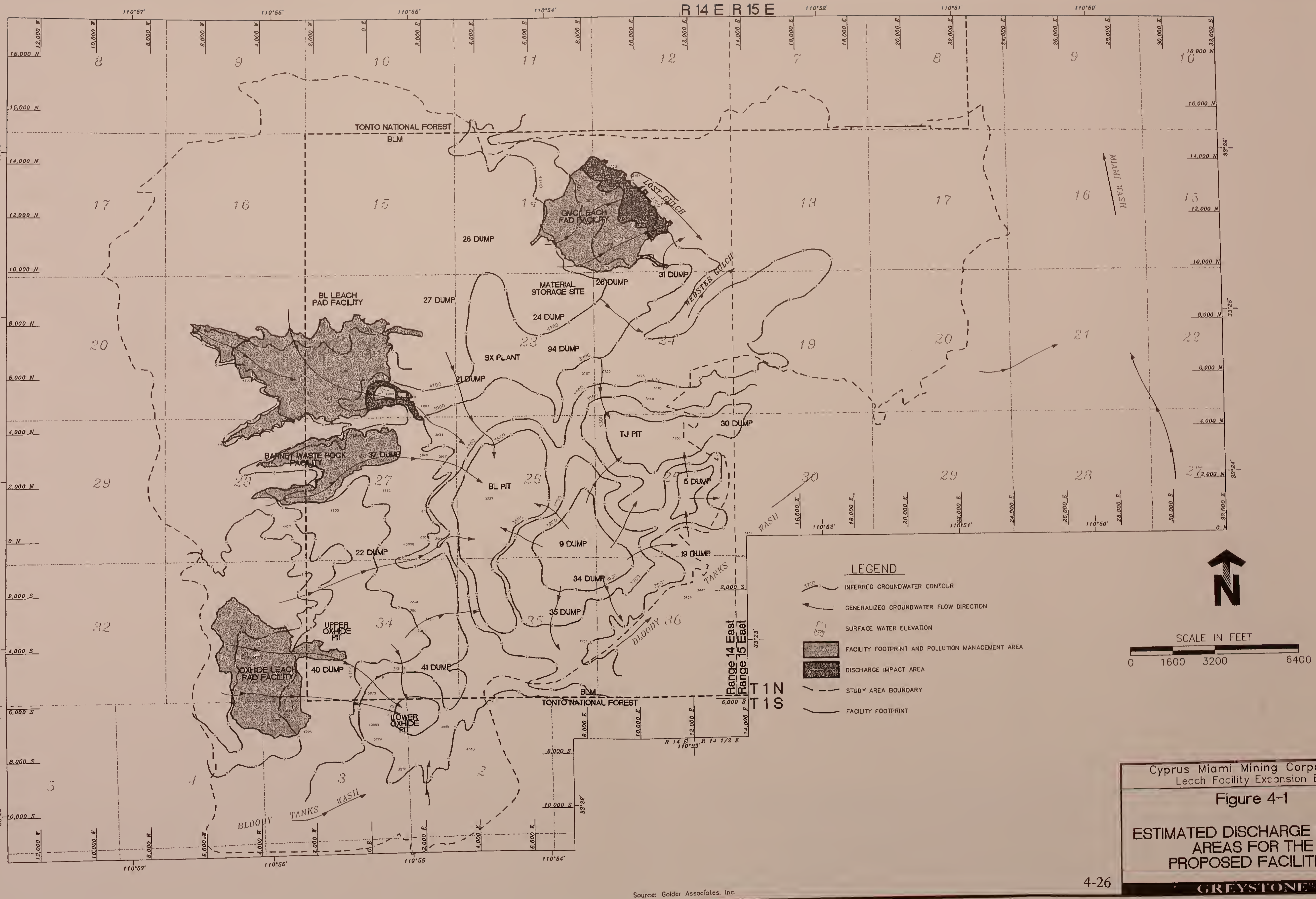
5) At closure, the heap leach facilities would be drained down without rinsing and then regraded; this would facilitate surface drainage and minimize infiltration. A layer of inert overburden would then be added and the surface revegetated.

4.2.3.2.2 Barney Waste Rock Site

The impact to groundwater quality down-gradient of the Barney waste rock site should be minimal for the following reasons:

- Surface water up-gradient of the facility would be captured and diverted around the facility. Seepage through the waste rock would be limited to precipitation that falls on the facility.

- The waste rock placed in the facility would consist of Gila conglomerate. The Gila conglomerate should not produce acidic groundwater and, in fact, has some ability to neutralize acidic groundwater. This is described in detail in the materials characterization performed by Golder Associates Inc. (1995f).



Cyprus Miami Mining Corporation
Leach Facility Expansion EIS

Figure 4-1

ESTIMATED DISCHARGE IMPACT AREAS FOR THE PROPOSED FACILITIES

GREYSTONE

- The BL pit, located approximately 3000 feet down-gradient of the Barney waste rock site, should capture seepage from the facility if such seepage does occur.

- The groundwater below the facility is potentially impacted. For the reasons described above, it is unlikely that material placed in the Barney waste rock site will further significantly degrade groundwater quality.

4.2.3.2.3 Mine Pits

The impact to groundwater quality in the mine pits as a result of the Proposed Action should be minimal for the following reasons:

- The groundwater in the Project Area and the vicinity of the pits is currently impacted from past mining activities; this is described in Chapter 3, Section 3.3.1.3.2. For the reasons described above in items 1-3 under 4.2.3.2.1 Leaching Facilities, it is unlikely that groundwater reporting to the pits from the leaching facilities will further degrade groundwater quality.

- The rock adjacent to the pits is highly mineralized; the quality of groundwater flowing through this mineralized rock is naturally altered.

4.2.3.3 Groundwater Effects - Cumulative

No further cumulative effects to groundwater quantity or quality were identified as a result of the Proposed Action. Cumulative effects would occur to groundwater quantity in the regional aquifer due to extended life of pumping to dewater the mine pits.

4.2.3.4 Mitigation Measures and Monitoring

The following mitigation and monitoring measures would be implemented for groundwater quality:

- A Quality Assurance/Quality Control (QA/QC) plan has been developed for installation of the geomembrane lining systems at the leaching facilities. Implementation of the QA/QC plan would be documented to ensure a high standard of installation for the geomembrane liners. The primary goal of the QA/QC plan is to minimize the number and size of breaches in the geomembrane liners (Golder Associates Inc. 1996c).

- Groundwater monitoring would be implemented in accordance with the State of Arizona Aquifer Protection Permit (APP) for the facilities. Groundwater quality monitoring would use selected wells from the existing groundwater monitoring network. Details concerning the number and location of such wells have yet to be finalized. The primary goal of such monitoring is to detect groundwater contamination so that corrective measures can be taken before polluted groundwater leaves the project area.

- The facility drainage systems, evaporation/sediment ponds and surface diversions would be inspected periodically to ensure that: a) they are functioning properly, and b) no surface discharges from these facilities are occurring to Waters of the United States. Maintenance on the facilities would be performed as necessary.

- A QA/QC plan would be developed to ensure implementation of the Waste Rock Handling Plan (Golder Associates Inc. 1996d).

- Cyprus Miami would investigate closure technologies for copper oxide heap leach facilities throughout the life of the project. Cyprus Miami would submit a report concerning that research to the Forest Service and the BLM once every two years. Cyprus Miami would submit their recommended closure of the leach facilities to the Forest Service and the BLM two years prior to actual closure.

4.2.4 Water Resources - Surface Water

4.2.4.1 Surface Water Effects - Quantity

4.2.4.1.1 Leaching Facilities

The leaching facilities would have the following impacts to surface water quantity and drainage patterns within the project area:

- Current drainage patterns would be altered. Surface runoff originating up-gradient of the leach facilities would be diverted around the facilities and routed to down-gradient sumps and ponds. Some of this water would evaporate; the rest will be used for mining operations. Diversion channels are designed to accommodate runoff from the 24-hour, 100-year storm event (5.5 inches of rain). Surface water diversions are described in Chapter 2 of this document; additional detail is contained in the *Mining Plan of Operations (1996).*

- The 938 total acres of new disturbance covered by the three leach facility sites would no longer contribute to surface runoff. Precipitation falling on the leach sites would be contained within the process water circuits of the heap leach facilities and reused in the closed circuit operations.

- The leach facilities would cover or fill 16 water sources listed in **Table 4-6** and shown in **Figure 3-9.** The water from these sources, which is small in quantity and currently used by livestock and wildlife, would largely be collected by the underdrain system and used in the mining operations or discharged in accordance with State and federal regulations. The underdrain system is described in Chapter 2 of this document; additional detail can be found in the *Operating Plan (Cyprus Miami Mining Corporation 1996).*

4.2.4.1.2 Barney Waste Rock Site

The Barney waste rock site would have the following impacts to surface water quantity and drainage patterns within the Project Area:

- Current drainage patterns would be altered. Surface runoff originating up-gradient of the facility would be captured by diversions and transported to down-gradient sumps and ponds. Some of this water would evaporate; the rest would be used for mining operations. Diversion channels are designed to accommodate runoff from the 24-hour, 100-year storm event (5.5 inches of rain). Surface water diversions and embankments are described in detail in the *Mining Plan of Operations (1996).*

- The facility would cover two water sources listed in **Table 4-6** and shown in **Figure 3-9.**

4.2.4.1.3 Mine Pits

The Proposed Action would have the following minor impacts, which are not impacts to current surface water quantity and drainage patterns:

- The expansion of the BL pit would increase the capacity of that pit to store surface runoff from storm events.

- With the exception of the TJ pit, none of the other mine pits would be changed in size; therefore, there is no change to their water storage capacities; the partial backfilling of the TJ pit may affect its water storage capacity.

4.2.4.2 Surface Water Effects - Quality

4.2.4.2.1 Leaching Facilities

The three leaching facilities should have little or no impact to surface water quality. This conclusion is based on the following:

- Surface runoff originating up-gradient of the leach facilities would not come in contact with the leaching facilities; this water would be captured before it reaches the leaching facilities and diverted to down-gradient sumps and ponds, or in the case of the BL impoundments, be evaporated. Diversion channels are designed to accommodate runoff from the 24-hour, 100-year storm event (5.5 inches). The two impoundments up-gradient of the BL facility can store considerably more runoff than that generated by the 24-hour, 100-year storm. Surface water diversions and embankments associated with each leaching facility are described in Chapter 2 of this document; additional detail is contained in the *Operating Plan (Cyprus Miami Mining Corporation 1996).*

Table 4-6. Water Sources Covered or Filled by the Proposed Facilities

Facility	Name of Water Feature	Type of Water Source	Number of Water Rights Filed	Waters of the United States
Oxhide Leach	OXPND-1	earthen pond	0	yes
	OXSEEP -1	seep	3	yes
	2 Unnamed Ponds	earthen ponds	0	no
BL Leach	Frog Tank (a.k.a. Unnamed Tank)	earthen pond	3	no
	BLSPR-4	artesian borehole	3	no
	Little Pasture Tank (@ BLSPR-4)	earthen pond	●	no
	BLSPR-3 (Moonlight)	spring	●	no
	BLSPR-5 (Vigor of Life)	spring	●	no
	BLSPR-6	spring	0	no
	BLPND-1 (Upper Webster)	earthen pond	●	no
	Middle Webster Tank (dry)	earthen pond	●	no
	Lower Webster Tank (dry)	earthen pond	3	no
	BLPND-2	earthen pond	3	no
GMC Leach	GMCSPR-1 (Ralston Canyon)	spring	1	no
	GMCSEEP-1 (or GMCSTR-1)	seep	3	yes
Barney Waste	BOPND-1	earthen pond	0	no
	BOSPR-1 (Sycamore)	spring	1	no

- Precipitation falling on the leach facilities would not leave the leach sites as surface runoff. This precipitation would infiltrate into the leach pad and be collected by the underdrain system and reused in the mining operations.

- At closure, the heap leach facilities would be drained down without rinsing and then regraded to facilitate surface drainage and minimize infiltration. A layer of overburden would be added to the features and the surface revegetated. Erosion protection would be achieved through the use of stormwater runoff collection channels to drain and collect sediment. Revegetation would be the primary long-term erosion control method.

4.2.4.2.2 Barney Waste Rock Site

The Barney waste rock site should have no significant impacts to surface water quality for the following reasons:

- Surface runoff originating up-gradient of this facility would be captured before it reaches the site and diverted to down-gradient sumps and ponds. Diversion channels are designed to accommodate, at a minimum, runoff from the 24-hour, 100-year storm event (5.5 inches). Surface water diversions associated the Barney waste rock site are described in Chapter 2 of this document; additional detail is contained in the *Mining Plan of Operations (1996).*

- Precipitation that falls on the waste rock in this facility should not emerge as acidic seepage. The primary reason for this is that the waste rock that would be deposited to this facility is not acid-producing, and, in fact, has some ability to neutralize acidic water (Golder Associates, Inc. 1995f).

- At closure, the top crest and slopes would be; a) resloped and stabilized to facilitate surface drainage and minimize infiltration, and b) revegetated for erosion protection.

4.2.4.2.3 Mine Pits

Water in the pits is currently impacted by past and present mining activities; this is described in Chapter 3 of this document. Additional impacts to water in the pits is unlikely for the following reason:

- The leaching facilities, which are located up-gradient of the mine pits, should not affect surface water quality for the reasons previously described under the section 4.2.4.2.1. Leaching Facilities.

4.2.4.3 Surface Water Rights

The 22 surface water rights for sources within the Project Area are tabulated in **Table 4-7**. Water rights associated with streams (such as Needle Creek and Webster Gulch) would not be impacted as the place of use and type of use (industrial) would not change. However, all other water rights filings would be affected.

Certificates of Water Right (CWRs) for springs underlying the proposed facilities (i.e., Vigor of Life Spring, Ralston Canyon Spring and Moonlight Spring) would be required by the Arizona Department of Water Resources (ADWR) to undergo a "sever and transfer" process in order to change the place and type of use. As part of the expansion process, water from springs and storm water runoff would be collected in the underdrain system and recycled into downstream process ponds. During mining operations, the certificated water rights for springs would be available for industrial use rather than the currently identified stock watering and wildlife uses.

Table 4-7. Surface Water Filings in the Project Area

State File Number	Landowner	Claimant	Description	Impact	Facility
36-69713	[1]BLM	[2]CMMC	Upper Webster Pasture Tank (BLPND-1)	[3]Change	[4]BL
38-69731	BLM	CMMC	Upper Webster Pasture Tank (BLPND-1)	[5]Lost	BL
33-74042	BLM	CMMC	Webster Gulch	None	BL
38-17401	BLM	BLM	Upper Webster Pasture Tank	Lost	BL
36-69715	BLM	CMMC	Lower Webster Pasture Tank	Change	BL
38-69735	BLM	CMMC	Lower Webster Pasture Tank	Lost	BL
38-89073	BLM	BLM	Lower Webster Pasture Tank	Lost	BL
36-69716	BLM	CMMC	Middle Webster Pasture Tank	Change	BL
38-69737	BLM	CMMC	Middle Webster Pasture Tank	Lost	BL
38-17399	BLM	BLM	Middle Webster Pasture Tank	Lost	BL
38-17421	BLM	BLM	Schultz Tank	Lost	
4A-4282 [6](CWR 2685)	BLM	CMMC	Vigor of Life Spring (BLSPR-5)	[7]S&T	BL
[8]PWR 107	BLM	BLM	Vigor of Life Spring (BLSPR-5)	Lost	BL
38-69729	[9]USFS	CMMC	Little Pasture Tank (BLSPR-4)	Lost	BL
36-69715	USFS	CMMC	Little Pasture Tank (BLSPR-4)	Change	BL
38-83833	USFS	USFS	Unnamed Tank	Lost	BL
38-69727	USFS	CMMC	Frog Tank	Lost	BL
38-69729	USFS	CMMC	Frog Tank	Change	BL
36-23654	CMMC	CMMC	Needle Creek	None	[10]OX
36-21237	CMMC	CMMC	Sycamore Spring (BOSPR-1)	Change	[11]BW
4A-4277 (CWR 2681)	CMMC	CMMC	Ralston Canyon Spring (GMCSPR-1)	S&T	[12]GMC
4A-4281 (CWR 2684)	USFS	CMMC	Moonlight Spring (BLSPR-3)	S&T	BL

[1] Bureau of Land Management
[2] Cyprus Miami Mining Corporation
[3] Change in place of use and type of use
[4] BL Leach Facility
[5] Irretrievably Lost
[6] Certificate of Water Right
[7] Sever and Transfer
[8] BLM Federal Reserved Right
[9] United States Forest Service
[10] Oxhide Leach Facility
[11] Barney Waste Rock Facility
[12] GMC Leach Facility

Statements of Claim of Water Rights ("36"-numbered filings) for springs (i.e., Sycamore Spring) and stock watering uses at "points" along drainages (at the sites of Upper, Middle and Lower Webster Tanks, Little Pasture Tank and Frog Tank) will need to be amended to show changes in point of diversion, place of use and type of use.

The BLM's federal reserved right on Vigor of Life Spring (BLSPR-5), Public Water Reserve No. 107 (PWR 107), is not a transferable right and, as such, will be irretrievably lost by the Proposed Action.

Also lost as a result of the Proposed Action will be the stockpond claims ("38"-numbered filings) for a right to use water stored in a stockpond. The sources of these claims (i.e., the ponds) will be covered by the facilities.

4.2.4.4 Waters of the United States

Wetlands

A total of 0.06 acres (an area about 50 ft. by 50 ft.) of wetlands would be affected within the project area by the proposed action. The OXSEEP 1 wetland, dominated by rushes and bermuda grass, would be lost with the construction of the Oxhide leach facility (**Figure 3-10**). The OXSEEP is the result of a manmade impoundment. The GMC-SEEP wetland, dominated by cattails, would be lost with the construction of the GMC leach facility.

Open Water

A total of 5.22 acres of jurisdictional open water and approximately 6.6 acres of non-jurisdictional open water would be affected within the project area by the implementation of the proposed action. The loss would include three ponds at the Oxhide facility and one reservoir at the BL facility. Two reservoirs would be constructed at the BL facility for a potential maximum of 84 acres of open water habitat. However, these reservoirs would be dry from time to time.

The mitigation plan for loss of Waters of the United States, as determined by the U.S. Army Corps of Engineers, includes:

- The 3.94 acres of lost washes would be mitigated with the construction of diversion channels surrounding the three leach facilities and the Barney waste rock site.

- The 5.22 acres of lost surface impoundments would be mitigated by the creation of the Webster Gulch and Little Pinto Canyon impoundments. These impoundments would be located up-gradient of the BL Leach Facility.

- The loss of 0.06 acres of wetlands would be mitigated by the wetland vegetation that will develop around Webster Gulch and Little Pinto Canyon impoundments.

- In addition to the above planned mitigation, an 8.0 acre area owned by Cyprus Miami located adjacent to Pinal Creek would be restored to a native bosque. This area has been used as a horse pasture and currently has very little vegetation. Establishment of this riparian habitat mitigates for the lost wetlands and xero-riparian washes habitat at a ratio of 2:1. Mesquite bosque is a high value riparian habitat.

  Establishment of the mesquite bosque would be accomplished by planting nursery grown containerized plants of tree species native to the habitat in the general area. Plants would be protected from grazing by an existing fence and by using good management practices.

  Trees would be planted at a density of about 50 to 60 per acre. About 75% of the plants would be mesquite. The remaining 25% would be other native species often associated with mesquite, such as: catclaw acacia, whitethorn acacia, desert hackberry, wolfberry, and others. A detailed mitigation plan is being developed in concert with the US Army Corps of Engineers as a part of the requirements for a Clean Water Act Section 404 permit.

4.2.4.5 Cumulative Effects

No cumulative effects were identified off-site. This is because the identified impacts would either be fully mitigated or would not extend beyond Cyprus Miami property boundaries. All affected surface drainages are either intercepted by Cyprus Miami facilities, or are protected from discharges by Cyprus Miami's area-wide surface water management plan.

4.2.4.6 Mitigation Measures and Monitoring

- Mitigation for the loss in quantity and availability of surface waters for livestock and wildlife uses would consist of construction of the Webster Gulch and Little Pinto Canyon impoundments; these two impoundments would be located up-gradient of the BL Leach Facility. These new impoundments, along with existing diversions and ponds that would remain after closure, would mitigate the loss of the springs, seeps, and ponds currently used by livestock and wildlife.

- There is no mitigation for the loss or amendment of surface water rights. However, the water rights claimants would need to notify ADWR that the water sources would be lost or changed due to the mining operation. Water rights (and accompanying Salt River adjudication claims) lost by the Proposed Action would be withdrawn; "changed" rights would go through the sever and transfer process or simply be amended to change the point of diversion, place of use or type of use on National Forest System lands, Water rights on BLM lands may be transferred as part of a future land exchange or would be "unavoidably lost".

- Mitigation for open water and riparian areas would be accomplished as described above. The effectiveness of the mitigation measures is predicted from hydrologic models using

annual rainfall, runoff, and evaporation values. To document the effectiveness, as soon as the impoundment is constructed, Cyprus Miami would initiate real time monitoring of actual water levels in the impoundment. If actual water levels are similar to predicted levels, the mitigation would be considered successful. In the absence of predicted water levels, Cyprus Miami would develop plans, in consultation with the agencies, to promote riparian area enhancement in other locations.

- Surface water quality monitoring would occur for the life of the project and during closure. The details concerning surface water quality monitoring have not been finalized. The monitoring plan must be approved by the Forest Service and the BLM in coordination with ADEQ. The primary goal of such monitoring is to detect surface water contamination that may occur from the three heap leach facilities so that corrective measures can be taken.

- Periodic inspections of the diversion structures would be required for a number of years after closure. The frequency of inspections and the duration of the monitoring program would be determined by the Forest Service and the BLM during project permitting and construction. The diversion structures may need to be reconfigured at closure so as to minimize the need for ongoing maintenance.

4.2.5 Soils

Issues that were raised about soils and reclamation during scoping included the adequacy of reclamation relative to current land uses, the adequacy of reclamation relative to site-specific conditions, whether concurrent reclamation would be implemented, the susceptibility of the leach pads to weathering and erosion, and the adequacy of the reclamation bond to ensure compliance with agency guidelines and goals.

Several evaluation criteria were identified to address the potential for reclamation, including: the amount of area requiring the restoration of topsoil or suitable substitute growth medium, the available volume of salvageable growth medium (topsoil and subsoils), the amount of area on which post-reclamation objectives cannot be met, the projected post-disturbance soil loss for the area, anticipated post-reclamation maintenance and inspection costs, and the degree to which mine reclamation would restore ecosystem functions and values to disturbed areas.

Possible impacts to soils would involve loss of productivity and removal through erosion. Direct, short-term losses of soil productivity would occur in disturbance areas as a result of construction and operations in disturbed areas that would ultimately be reclaimed.. These disturbance areas include the Oxhide, BL, and GMC pads; ancillary facilities associated with these pads; and the Barney overburden facility. **Table 3-13** presents the acreage of each soil type present in the disturbance areas. Total new disturbance of soils would be approximately 199 acres within the Oxhide pad, 464 acres within the BL pad (including the two

impoundments), 275 acres within the GMC pad, and 119 acres within the Barney overburden facility.

Indirect effects on soils would be associated with the potential for increased erosion during operations and erosion from the Barney waste rock facility. Long term losses of soil productivity would occur in areas not revegetated, i.e., 386 acres of the BL facility, 228 acres at GMC, 127 acres at Oxhide, and 44 acres at Barney.

An estimate of sediment production following reclamation was made using data from hydrologic modeling (**Table 4-8**). This sediment modeling based on curve numbers which did not have the benefit of detailed soil and vegetation mapping and reflect a conservative worst-case condition (Golder Associates, Inc.1995d). Sediment losses pre- and post-mining may not be as distinct as presented by these analyses. Pre-mining estimates considered undisturbed native ground and post-mining estimates considers the final configuration leach facilities with benches and terraces and following reclamation. The Cyprus Miami Expansion Project Reclamation Plan (Golder, 1995d) includes estimates of sediment loss for the undisturbed watersheds above the leach pads and the overburden storage site, as well as for the reclaimed configurations of the expansion facilities.

Table 4-8. Comparison of Soil Loss Estimates Between Existing Conditions and Following Reclamation

Mine Expansion Facility	Pre-Mining Annual Soil Loss (Tons/Acres)	Post-Mining Annual Soil Loss (Tons/Acres)	Percent Change in Soil Loss
BL Leach Pad	< 8.33	5.21	(37)
GMC Leach Pad	< 4.79	3.13	(35)
Oxhide Leach Pad	< 9.17	5.00	(45)
Barney Waste Rock Facility	< 5.42	6.88	26

Source: Analysis of data from Golder Associates, Inc., 1995d

The reclaimed leach pads would have gently sloping, vegetated crests and contour benches along the rocky side slopes. The Barney waste rock facility would have a smaller crest to sideslope ratio, resulting in more rocky side slopes, which would contribute to the higher soil loss value.

4.2.5.1 Cumulative Effects

The previously disturbed area for Cyprus Miami's operations totals 5,640 acres. When combined with the proposed additional disturbance of 1,057 acres, Cyprus Miami's total cumulative soils disturbance in the project vicinity would be 6,697 acres. Other mines include

existing operations at the BHP Copper, Inc., Miami unit and Pinto Valley mine which is located in a different hydrologic drainage system. Within a 2-mile radius of the project area, cumulative disturbance would be 15,454 acres of soils (**Table 4-1**). The resultant effects would be increased erosion and soil losses in the area.

4.2.6 Biological Resources

Issues raised during scoping included the potential for impacts to protected plant species, to wetland areas, and to the special status species Arizona hedgehog cactus and Arizona agave. Other issues were the potential for impacts to wildlife habitat and watering sources, the amount of habitat loss, potential toxicity to waterfowl from leachate solutions in ponds and ditches, and cumulative impacts to wildlife through removal of habitat. There was also concern for the potential to enhance wildlife habitat through the creation of new water impoundments and wetlands.

Evaluation criteria for these issues include the number of acres of habitat loss by vegetation community, the relative value of the affected habitats, estimates of the populations of major wildlife species that would be affected or displaced, the probability of impacts to wildlife from accidental release of chemicals, the number of acres of potential and occupied habitat for special status species, the number of individuals of special status species that could be affected relative to their overall populations, and the number of other sensitive species whose populations may be affected by the project. The potential effects on the lesser long-nosed bat was also raised as a wildlife issue.

4.2.6.1 Vegetation

Criteria that were used to evaluate potential impacts of the proposed project and the alternatives on vegetation include the following:

- Acres of vegetation lost or degraded by community type (e.g., cottonwood-willow, juniper scrub),
- Sensitive species whose individuals may be adversely affected by the project and lead to a listing of the species.

4.2.6.1.1 Upland Vegetation Communities

Oak Chaparral

Oak chaparral is the most widespread and well developed community type occupying approximately 85 percent of the upland areas in the study area. Of the 5,815 acres of oak chaparral that occur within the study area, approximately 902 acres would be directly affected by the proposed action. Approximately 382 acres of oak chaparral would be disturbed by the

construction of the BL leach facility and its associated reservoirs. The construction of the Oxhide, Barney, and GMC leach facilities would disturb 199, 47, and 274 acres of oak chaparral, respectively. **Table 4-9** presents the disturbance acres from construction of the pads, collection ponds, roads, etc. associated with the implementation of the proposed action by vegetation type by leach facility. Relative to the widespread occurrence of this community in the vicinity of the proposed project, the number of acres directly affected by the proposed action would be relatively small.

Pinyon/Juniper Woodland

Pinyon/juniper woodland covers approximately 520 acres or 8 percent of the study area (**Table 4-9**). Of this area, 76 acres would be directly affected by the project. All 76 acres of the disturbed pinyon/juniper woodland community type occur within the proposed disturbance area for the BL leach facility and its associated reservoirs. Pinyon/juniper woodlands are the

Table 4-9. Total Acres of Vegetation Types Impacted

Vegetation Type	Total Acreage within Vegetation Study Area	Affected Acreage				Total Affected Acreage
		Oxhide	Barney	BL	GMC	
Upland	7,960	199	118	461	274	1,052
Oak Chaparral	5,815	199	47	382	274	902
Oak Woodland	565	0	0	0	0	0
Pinyon/Juniper Woodland	520	0	0	76	0	76
Juniper Scrub	430	0	71	•	0	74
Palo verde/cacti desert scrub	630	0	0	0	0	0
Riparian	74	•	1	3	1	6
Fremont Cottonwood	30	0	0	•	1+	<1
Freemont Cottonwood/Goodding Willow	23	0	0	0	0	6
Goodding Willow	1	•	0	0	0	1
Arizona Sycamore/Fremont Cottonwood	18	0	1	0	0	1
Tamarisk	2	0	0	0	<1	<1
Total[1]	8,034	199	119	464	275	1,057

[1]Rounding and GIS interpretation may account for some slight discrepancies in totals of disturbance acres.

fourth most common community type occurring within the study area. Relative to the amount of this habitat available in the Pinal Mountains, the loss of pinyon/juniper woodland habitat by the proposed action would be very small.

Juniper Scrub

Juniper scrub occupies a total of 430 acres or 5 percent of the study area (**Table 4-9**). Of this area, 74 acres would be directly affected by the proposed action. Construction of the Barney leach facility would impact 71 of those 74 acres. The other three acres would be impacted by the construction of the BL leach facility. This habitat type is found at scattered locations throughout the Pinal Mountains.

4.2.6.1.2 Riparian Vegetation Communities

Within the general region, riparian vegetation communities are important for wildlife corridor movement and watering. The regional alignment of drainages within the study area do not offer many wildlife corridor opportunities because they are interrupted down-gradient by the existing Cyprus Miami mine. Approximately 7 acres of riparian communities (13 percent of all riparian communities within the study area) would be eliminated by the proposed action. All of the impacted riparian vegetation occurs adjacent to existing disturbance.

Fremont Cottonwood

Fremont cottonwood occupies 33 acres within the study area. Of this area, 4 acres would be directly affected by the proposed action. Three of these acres occur within the proposed disturbance area for the BL leach facility and its associated reservoirs and one acre occurs within the proposed GMC site.

Goodding Willow

Only 0.7 acres of the Goodding willow community occurs within the study area. Of this area, 0.4 acres would be directly affected by the proposed action. All of this disturbance would be attributed to road construction and related activities at the Oxhide leach facility.

Arizona Sycamore/Fremont Cottonwood

Eighteen acres of this community type occur within the study area of which 0.6 acres would be directly affected by the proposed action. This disturbance would result from construction of the Barney waste rock facility and related activities.

Tamarisk

Tamarisk occupies approximately 2 acres within the study area, of which 0.1 acres would be directly affected by the proposed action at the GMC site. All of this disturbance would be attributed to road construction and related activities.

4.2.6.1.3 Endangered Plant Species

Arizona Hedgehog Cactus

No Arizona hedgehog cactus were found after systematic survey of the proposed facility sites. Implementing the proposed action would have no effect on Arizona hedgehog cactus.

Arizona Agave

No Arizona agave were found within the survey area. Implementing the proposed action would have no effect on Arizona Agave.

4.2.6.1.4 Sensitive Plant Species

None of the four sensitive species of plants identified in Chapter 3 were found within the study area. Therefore, implementation of the Proposed Action would have no effect on these sensitive species of plants.

4.2.6.1.5 Cumulative Effects

Both upland and riparian vegetation would be disturbed, 1,052 acres and 7 acres, respectively. Approximately 272 acres of disturbed area would be reclaimed after site closure. The remaining 785 acres of disturbance in the project area would be stabilized and allowed to naturally revegetate by invasion from surrounding undisturbed areas over a period of several decades following mine closure. The revegetation seed mixture used on the 272 acres would be a combination of various shrubs, grasses, and forbs and would be developed jointly with the agencies and Cyprus Miami. Species common to the adjacent undisturbed areas would be used to reseed disturbance areas.

In combination with Cyprus Miami's previous disturbance area, the disturbed areas of BHP Copper, Inc., and the proposal by Carlota Copper, the cumulative loss of vegetation would be approximately 15,454 acres prior to reclamation (**Table 4-1**). An unknown portion (on the order of 10 to 15 percent) of the 15,454 acres has already been revegetated.

4.2.6.1.6 Mitigation Measures and Monitoring

A habitat management and monitoring plan would be prepared as an integral part of monitoring according to the U.S. Army Corps of Engineers requirements. Salvage of succulents and cacti from the proposed disturbance areas would also be included as a mitigation measure for sensitive species.

4.2.6.2 Wildlife

Evaluation criteria for wildlife issues included:

- number of acres of habitat lost,
- estimates of populations displaced,
- potential effects from chemical releases, and
- the numbers of special status species that could be affected.

Each of the proposed facilities would occur adjacent to areas that have previously been disturbed by the existing Cyprus Miami mine and ranching operation. The GMC leach facility is nearly surrounded by existing Cyprus Miami disturbance. The BL leach facility, Barney waste rock site, and the Oxhide leach facility all occur adjacent to the existing Cyprus Miami mine. Therefore, all the proposed facility sites have already experienced limited human disturbance and exploration or condemnation drilling has been conducted at various locations.

Under the Proposed Action alternative, construction of the leach pad sites would directly remove habitat for wildlife within the project area. Approximately 1,057 acres of wildlife habitat would be impacted under the Proposed Action. Most of the disturbance would occur within the oak chaparral and pinyon/juniper woodland vegetation types. **Table 4-9** describes the amount of existing vegetation andhabitat type and the approximate amount of each that would be directly impacted under this alternative.

Although habitats would be permanently lost to wildlife as a result of the proposed project, the amount of habitat north of the project area may be able to absorb some of the displaced wildlife. However, upon the completion of mining, reclaimed areas would provide foraging potential allowing for the repopulation of the area. Approximately 785 acres of current habitat would be left as unreclaimed area to revegetate naturally. The amount to be reclaimed (272 acres) would be temporarily lost but would be revegetated.

Potential indirect effects would also occur for various wildlife species. This indirect loss of habitat would be related to mining activities that affect the suitability of habitats that are not physically disturbed, but are in the vicinity of mining activities. These activities include haul and access road noise, and the general increase in human activities associated with mining. The magnitude, duration, and intensity of these effects on wildlife are highly variable, depending upon the species and habitats involved. This area has been a mining area for decades, and area wildlife are likely accustomed to mining-related disturbances.

Associated with the Proposed Action is the construction of leachate collection reservoirs. The leach solutions within the reservoirs are characterized by high concentrations of total dissolved solids, heavy metals, sulfates, and low pH values. These reservoirs would impact wildlife species which come in contact with the solution. Currently the existing reservoirs within the mine do not have wildlife exclusion protection. Information provided by mine personnel indicates that wildlife mortality related to these facilities is minor with many years having no

reports of mortalities (Whitman 1996). In addition, a 1992 study indicates that although leachate reservoirs within Arizona are open to bird use, there have been no reported bird mortalities related to these reservoirs (BLM 1992). Therefore, Cyprus Miami does not anticipate installing wildlife exclusion protection for birds around the reservoirs. However, if mortalities do arise from the reservoirs, Cyprus Miami would install the proper exclusion protection. The reservoirs would be fenced to exclude livestock and larger wildlife.

A total of three riparian corridors would be filled by both the BL leach facility and the Barney waste rock facility. Riparian habitats are limited in area (77 acres in the study area) and account for less than one percent of the entire study area. Approximately 5 acres of riparian habitat would be lost under the action alternatives. These riparian areas are considered important as wildlife habitat.

Two new surface fresh water retention impoundments would be created as a result of the Proposed Action alternative. The impoundments would be constructed in conjunction with the BL leach facility. Open water habitats currently comprise a small portion of the project area (11.8 acres), and the new impoundments would provide additional open water habitat. The two impoundments would have a maximum potential surface area of 84 acres. However, it is unlikely they would ever fill to that maximum. The 200-year water balance indicates that the Little Pinto Canyon likely would be dry the majority of the time, thus preserving the upgradient riparian area. The Webster impoundment is expected to impound water, creating a pond that may be about 5 to 8 acres. These habitats would be important as a potential watering resource for wildlife, and would provide potential habitat for waterfowl.

4.2.6.2.1 Effects on Specific Wildlife Species

The study area of about 13,000 acres is contained within AGFD Management Unit 24B for all wildlife species and accounts for approximately 2.5 percent of the Unit. Approximately 1 percent of the unit has already been disturbed by existing mining. Therefore, the actual affected area would be about 1.5 percent of the Management Unit.

Mule and white-tailed deer are known to occur throughout the project area. They are typically associated with all habitat types within the study area, and both utilize the area as year-round habitat. White-tailed deer, however, generally occur at higher elevations than mule deer. The AGFD estimates a density of 1 to 5 mule deer per square mile within the project area. In addition, the density of white-tailed deer in the Unit is estimated as 5 to 7 deer per square mile, except in the area of the Oxhide leach facility which supports a density of only 1 to 5 deer per square mile.

Approximately 1,057 acres or 13 percent of the potential deer habitat within the study area may be affected. The majority of habitat lost would occur within the BL leach facility (477 acres). Based on the low density of deer and the minor amount of habitat that would be affected, the impacts on deer are expected to be minor.

Javelina are associated with all habitat types within the study area. The AGFD estimates a population density of 0.5 to 1.5 javelina per square mile within the study area. Approximately 1,057 acres or 13 percent of the available javelina habitat within the study area would be impacted as a result of this alternative. Due to the low density of javelina within the area, these impacts are anticipated to be minor.

Mountain lions may occur within the study area. They are typically associated with the oak chaparral, pinyon-juniper woodland, juniper scrub, and oak woodland habitat types. The AGFD estimates lion populations are moderate and stable within the Management Unit. The Proposed Action would impact approximately 1,057 acres or 13 percent of the available mountain lion habitat within the study area. Although mountain lion sign was observed within the study area, the small amount of proposed disturbance combined with the amount of ongoing disturbances in the area is not anticipated to adversely impact mountain lions.

Black bears are known to occur within the study area. They are generally restricted to the oak chaparral, oak woodland, and pinyon-juniper woodland habitat types within the study area. The AGFD estimates that 55 bears occur within the Management Unit. The proposed action would affect approximately 785 acres or 10 percent of the available bear habitat within the study area. This accounts for a small percentage (<1%) of the entire Management Unit. Therefore, this small amount of disturbance combined with the high amount of ongoing disturbance in the area is not expected to adversely impact black bears.

Javelina, predators, reptiles, amphibians, small mammals, songbirds, waterfowl, and upland game birds may occur within all habitat types of the study area. The proposed action would affect approximately 1,057 acres of the potential habitat for these species. This accounts for approximately 13 percent of the available habitat in the study area.

Raptors are anticipated to occur within all habitat types within the study area. Although all areas may not be used as nesting habitat, raptors may forage throughout the area. Placement of the BL leach facility would remove two active raptor nests. A red-tailed hawk nest and a Cooper's hawk nest occur within the riparian zone near Bohme Ranch. Both nests would be removed by construction in 1997. Cyprus Miami would have the nests monitored prior to construction to determine if the nests are still active. If the nests are active, the proper resource management agencies would be contacted to determine proper treatment of the nests.

Placement of the Oxhide and BL leach facilities would result in the loss of approximately 11.8 acres of open water impoundments which are potential waterfowl habitat. However, the addition of the two new impoundments at the BL leach facility would offset the loss of open water habitat in the project area.

4.2.6.2.2 Management Indicator Species

Table 4-10 describes each management indicator species and amount of potential habitats that may be affected by the Proposed Action. Management indicator species are the species

designated by the land management agency as being sensitive to environmental change and, therefore, to be monitored as indicators of broad-based environmental quality.

4.2.6.2.3 Threatened, Endangered and Sensitive Wildlife

The U.S. Fish and Wildlife Service has identified five threatened or endangered wildlife species that may potentially occur within the study area. In addition, the Forest Service and Bureau of Land Management have identified 32 sensitive species that may occur within the study area. **Table 4-11** presents potential for occurrence for these species plus the determination of effect if the Proposed Action is implemented.

The U.S. Fish and Wildlife Service has reviewed the Biological Baseline report (Golder Associates Inc. 1995i) used to develop this document and has concurred with our findings of "no effect" on all listed species except the lesser long-nosed bat. They concurred with "may affect, but not likely to adversely affect" the lesser long-nosed bat (Consultation number 2-21-94-1-330 dated 9/6/95).

Table 4-10. Management Indicator Species Habitat Potentially Affected

Vegetation Type	Species	Acres of Available Habitat (in the Study Area)	Habitat Lost by the Proposed Action (acres)
Pinyon-Juniper Woodland	Ash-Throated Flycatcher Gray Vireo Townsend's Solitaire Plains Titmouse Common Flicker Rufus-sided Towhee	520	76
Oak Chaparral	Rufus-sided Towhee Black-chinned Sparrow	5,815	804
Desert Scrub	Black-throated Sparrow Canyon Towhee	630	0
High Elevation Riparian (above 3,000 feet)	Hairy Woodpecker Arizona Gray Squirrel Warbling Vireo Western Woodpecker Black Hawk	54	< 7
Aquatic	Macroinvertebrates	< 10	< 10

Table 4-11. Summary of the Potential for Occurrence and Determination of Effect for Threatened or Endangered and Sensitive Species

Species	Potential to Occur Within Study Area	Determination of Effect
Threatened or Endangered		
Lesser long-nosed bat (*Leptonycteris curasoae yerbabuena*)	Unlikely to occur because site is outside known habitat area.	Not likely to adversely affect.
Peregrine falcon (*Falco peregrinus anatum*)	Occasionally may occur, area lacks suitable nesting/foraging habitat.	Will not affect the species or its habitat.
Bald eagle (*Haliaeetus leucocephalus*)	Occasionally may occur, area lacks suitable nesting/foraging habitat.	Will not affect the species or its habitat.
Southwestern willow flycatcher (*Empidonax trailli extimus*)	Unlikely to occur because of lack of suitable habitat.	Will not affect the species or its habitat.
Cactus ferruginous pygmy owl (*Glaucidium brasilianum cactorum*)	Unlikely to occur because of lack of suitable habitat.	Will have no effect on this species or its proposed critical habitat.
Forest Service and BLM Sensitive Species		
Spotted bat (*Euderma maculatum*)	Occasionally may occur	May impact individual bats, but is not likely to result in a trend toward federal listing or loss of viability.
California leaf-nosed bat (*Macrotus californicus*)	Occasionally may occur	May impact individual bats, but is not likely to result in a trend toward federal listing or loss of viability.
Occult little brown bat (*Myotis lucifugus occultus*)	Occasionally may occur	May impact individual bats, but is not likely to result in a trend toward federal listing or loss of viability.
Greater western mastiff-bat (*Eumops perotis californicus*)	Occasionally may occur	May impact individual bats but is not likely to result in a trend toward federal listing or loss of viability.
Small-footed myotis (*Myotis cilioabrum*)	Occasionally may occur	May impact individual bats, but is not likely to result in a trend toward federal listing or loss of viability.
Allen's big-eared bat (*Idionycteris phyllotis*)	Occasionally may occur	May impact individual bats, but is not likely to result in a trend toward federal listing or loss of viability.
Pale townsend's big-eared bat (*Plecotus townsendii pallescens*)	May occur regularly	May impact individual bats, but is not likely to result in a trend toward federal listing or loss of viability.
Big free-tailed bat (*Nyctinomopos macrotis*)	May occur regularly	May impact individual bats, but is not likely to result in a trend toward federal listing or loss of viability.
Long-legged myotis (*Myotis volans*)	Occasionally may occur	May impact individual bats, but is not likely to result in a trend toward federal listing or loss of viability.
Fringed myotis (*Myotis thysanodes*)	May occur regularly	May impact individual bats, but is not likely to result in a trend toward federal listing or loss of viability.
Yuma myotis (*Myotis yumanensis*)	May occur regularly	May impact individual bats, but is not likely to result in a trend toward federal listing or loss of viability.
Cave myotis (*Myotis velifer*)	May occur regularly	May impact individual bats, but is not likely to result in a trend toward federal listing or loss of viability.
Red bat (*Lasiurus borealis*)	Unlikely to occur	No impact

Table 4-11. Summary of the Potential for Occurrence and Determination of Effect for Threatened or Endangered and Sensitive Species

Species	Potential to Occur Within Study Area	Determination of Effect
Southern yellow bat (*Lasiurus ega*)	Unlikely to occur	No impact
Coati (*Nasua nasua*)	Extremely unlikely to occur. The range of this species is restricted almost entirely to areas south of the study area.	No impact
Ring-tail (*Bassariscus astutus flavus*)	May occur regularly	May impact individuals, but is not likely to result in a trend toward federal listing or loss of viability.
Western burrowing owl (*Athene cunicularia hypugea*)	Unlikely to occur. Soils are generally rocky and no burrowing owls were observed during fieldwork.	No impact
Ferruginous hawk (*Buteo regalis*)	Occasionally may occur	No impact
Loggerhead shrike (*Lanitus ludovicianus*)	Known to occur	May impact individuals, but is not likely to result in a trend toward federal listing or loss of viability.
American Bittern (*Botaurus lentiginosus*)	Unlikely to occur	No impact
Common black-hawk	Occasionally may occur	No impact
Harris' Hawk (*Parabuteo unicinctus*)	Extremely unlikely to occur	No impact
Green-backed heron (*Butosides striatus*)	Occasionally may occur	No impact
Belted kingfisher (*Ceryle alcyon*)	Occasionally may occur	No impact
Mississippi kite (*Ictinia mississippiensis*)	Occasionally may occur	No impact
Black-crowned night heron (*Nycticorax nycticorax*)	Occasionally may occur	No impact
Osprey (*Pandion haliaetus carolinensis*)	Occasionally may occur	No impact
Northern leopard frog (*Rana pipiens*)	Extremely unlikely to occur	No impact
Lowland leopard frog (*Rana yavapaiensis*)	Known to occur	May impact individuals, but is not likely to result in a trend toward federal listing or loss of viability.
Arizona toad (*Bufo macroscaphus*)	Occasionally may occur	No impact
Mexican garter snake (*Thamnophis eques*)	Extremely unlikely to occur. No extant or previously existing populations are known from the project area.	No impact
Maricopa tiger beetle (*Cicindela oregona maricopa*)	Occasionally may occur	May impact individuals, but is not likely to result in a trend toward federal listing or loss of viability.

Potential for occurrence is defined as follows: **Extremely Unlikely to Occur** (the study area is outside the species known range); **Unlikely to Occur** (habitats are not typical of those known to be used by this species); **Occasionally may Occur** (may occur during migration, dispersal, or while foraging, but habitats are not typical of those known to be used for breeding and/or no individuals were recorded during species-specific surveys); **May Occur Regularly** (habitats appear typical of those known to be used for breeding but no species-specific surveys were conducted); **Known to Occur** (species has been observed in the study area). Language used in determination of effect was based on the U.S. Forest Service's 1993 Documentation Desk Guide.

Surveys within the project area did not locate lesser long-nosed bats. The closest known records of this species are over 30 miles away. Potential forage species within the project area occur in low densities.

The project area does not contain potential peregrine falcon nesting habitat. Also, this species was not recorded during the surveys within the project area. The project area provides low quality potential foraging habitat that would likely not be used, given the availability of better foraging habitat. Implementing the proposed action alternative would not affect the species or its habitat.

The project area does not contain potential bald eagle nesting habitat. Also, this species was not identified during the surveys of the project area. The project area provides low quality potential foraging habitat that would likely not be used, given the availability of better foraging habitat. Implementing the proposed action alternatives would not affect the species or its habitat.

Surveys for the southwestern willow flycatcher did not locate any individuals within the project area. In addition, potential habitat for this species was not located within the project area. The potential for suitable habitat to develop in the project area is limited by water availability. Implementing the proposed action alternatives would not affect the species or its habitat.

The project area is outside of the elevational range of the cactus ferruginous pygmy owl. The vegetative components of potential habitat for this species do not occur within the project area. Implementing the proposed action would have no effect on the species or its proposed critical habitat.

Potential effects to Forest Service and BLM sensitive species are expected to be minor. This conclusion is based on the following considerations. First, the study area does not support suitable habitat for the majority of these species. Second, although habitat for the common black-hawk and ringtail occurs in the study area, no individuals were observed during the field surveys. Therefore, impacts to these sensitive species are anticipated to be minor.

The single population of native fish (longfin dace) identified in the project area would be directly impacted. This population is located in a water impoundment within the Oxhide leach facility site. The impoundment would be completely removed, eliminating the longfin dace population. No other native fish populations were identified within the study area.

4.2.6.2.4 Cumulative Effects

The cumulative effects on wildlife of past, present, and reasonably foreseeable future projects are considered similar to the effects of the proposed and existing projects. This conclusion is based on the following considerations. First, the proposed project is bordered on two sides by the Tonto National Forest. Habitats within this area are similar to those of the project area. Therefore, some of the wildlife displaced by the proposed action might find suitable habitat in

the surrounding area. Second, the Cyprus Miami area has historically been a mining area, and as such, area wildlife have become accustomed to mine-related disturbances in the area.

Third, no important habitats have been identified in the project area. Lastly, migratory bird mortality has not been a problem (one or two mortalities over the past several years) (Whitman, 1996). Bird mortality is not expected to be a concern in the future.

Currently, there is a separation of approximately two miles between the existing Cyprus Miami mine disturbance and the Pinto Valley Mine disturbance. The placement of the facilities would reduce this distance to approximately one mile. This would force wildlife into a smaller corridor as they move north-south through the area. However, this is not anticipated to have a substantial adverse impact on wildlife because no major migration patterns have been identified in the area.

This project would directly affect 1,057 acres of habitat. This acreage would be in addition to the 13,190 acres that have been disturbed by previous mining (**Table 4-1**) plus the 1,207 acres proposed for disturbance by the Carlota project. The cumulative impact would be to increase disturbance from the current 13,190 acres to 14,454. In addition, other lands in the area would also likely be affected by other mining projects in the future.To determine cumulative effects on sensitive fish species, the effects on fisheries of the proposed activities together with all other past, present, and planned actions within the analysis area were examined. Longfin dace was listed as a Forest Service and BLM sensitive species because of its continuing decline in distribution and numbers throughout its historic range, and loss of habitat. Cumulative effects would continue to contribute to this decline via elimination of the longfin dace population within the Oxhide facility site. Successful transplantation to the proposed impoundments would partially mitigate the loss of individuals.

4.2.6.2.5 Mitigation Measures and Monitoring

Measures that would mitigate for the loss of the native longfin dace would be the capture and transplant of a large portion of the population from the impoundment to at least one of the proposed surface water impoundments. This would allow continued existence of the longfin population and the genetic diversity it contains. Additionally, transplanting longfin dace to more than one impoundment might even increase its population and distribution.

4.2.7 Cultural Resources

Two issues were raised concerning cultural resources: the potential for direct impacts to known historic and prehistoric cultural sites, and indirect impacts to known resources due to increased access and use in and adjacent to the area. The single evaluation criteria to assess potential impacts was the number of prehistoric and historic sites directly or indirectly affected.

Implementation of the Proposed Action would potentially affect 32 of the identified cultural resource sites (**Table 4-12**). Of the 43 sites potentially eligible for the National Register of Historic Places within the study area parcels, 27 fall within the identified facility disturbance

Table 4-12. Summary of Cultural Sites Identified in Cyprus Miami Project Area

ASM Site No. AZV:9:[1]	Other No. (e.g. USFS)	Pad Area	Land Status[2]	Site Type	In Area of Proposed Effect[3]
53	AR-03-12-02-545	BL	Cyprus Miami	Field houses; large lithic scatter	Yes
177	AR-03-12-02-546	Oxhide	TNF	Water control system (CCC?)	Yes
326	AR-03-12-532	BL	TNF	Large lithic scatter	No
327	BJ-2	BL	BLM	Sparse artifact scatter	Yes
328	BJ-3	BL	BLM	Field house;lithic scatter	Yes
329	AR-03-12-02-543	BL	Cyprus Miami	Habitation	Yes
330	AR-03-12-02-544	BL	Cyprus Miami	Field house; artifact scatter	Yes
33[illegible]	AR-03-12-05-552	BL	Cyprus Miami	Concrete buildings (ranch?)	Yes
332	AR-03-12-02-546	BL	Cyprus Miami	Habitation; artifact scatter	Yes
333	AR-03-12-02-533	BL	TNF	Habitation; lithic scatter	Yes
33[illegible]	AR-03-12-02-534	BL	TNF	Mining road (wagon)	Yes
33[illegible]	AR-03-12-02-535	BL	TNF	Field house?; small artifact scatter	No
336	AR-03-12-02-536	BL	TNF	Roasting pit; small lithic scatter	Near[3]
33[illegible]	AR-03-12-02-547	BL	Cyprus Miami	Bohme ranch complex	Yes
338	AR-03-12-02-537	BL	TNF	Field house; small artifact scatter	Yes
339	AR-03-12-02-538	BL	TNF	Habitation; small artifact scatter	No
330	AR-03-12-02-535	BL	TNF	Stone alignments; lithic scatter	No
341	AR-03-12-02-540	BL	TNF	Artifact scatter; mine complex	No
342	DD-2	BL	BLM	Field house; artifact scatter	Yes

Table 4-12. Summary of Cultural Sites Identified in Cyprus Miami Project Area

ASM Site No. AZV:9:[1]	Other No. (e.g. USFS)	Pad Area	Land Status[2]	Site Type	In Area of Proposed Effect[3]
343	DD-3	BL	BLM	Field house?; artifact scatter	Yes
344	DD-4	BL	BLM	Check dams	Yes
345	AR-03-12-02-548	BL	Cyprus Miami	Sparse artifact scatter; mine adit and prospect	Yes
346	AR-03-12-02-549	BL	Cyprus Miami	Roasting pit; sparse artifact scatter	Yes
347	AR-03-12-02-550	BL	Cyprus Miami	Artifact scatter; historic millsite	Yes
348	AR-03-12-02-548	BL	TNF	Linear rock alignment (field house?)	Yes
349	DD-2	BL	BLM	Trash scatter	Yes
350	AR-03-12-02-542	BL	TNF	Stone foundation (habitation?)	Near[4]
351	AR-03-12-02-551	GMC	Cyprus Miami	Mine and mill site	Yes
35[illegible]	GMC-2	GMC	BLM	Depression Era habitation; prehistoric artifact scatter	Yes
353	GMC-3	GMC	BLM	Storage structure?	Near[3]
353	GMC-4	GMC	BLM	Processing or procurement	No
355	GMC-5	GMC	BLM	Habitation (1940s to 1960s)	Yes
357	AR-03-12-02-528	BL	TNF	Very small lithic scatter	Yes
368		GMC	BLM	Mine complex	No
369	AR-03-12-02-1338	GMC	Cyprus Miami	Mine complex	Yes
370	AR-03-12-02-1338	GMC	Cyprus Miami	Mine waste rock dump	Yes
371	AR-03-12-02-1338	BL	TNF	Mine adit	No
372	AR-03-12-02-1339	BL	TNF	Mine adit	Near[4]
373	AR-03-12-02-1340	BL	TNF	Mine adit	Yes

Table 4-12. Summary of Cultural Sites Identified in Cyprus Miami Project Area

ASM Site No. AZV:9:[1]	Other No. (e.g. USFS)	Pad Area	Land Status[2]	Site Type	In Area of Proposed Effect[3]
374	AR-03-12-02-1341	BL	TNF	Road segment	Near[3]
375	AR-03-12-02-1342	Oxhide	TNF	Road segment	No
376	AR-03-12-02-1344	Oxhide	TNF	Road segment	No
377	AR-03-12-02-1344	Oxhide	TNF	Road segment	No

Notes:
1. ASM = Arizona State Museum numbering system.
2. Land Status: CMMC = Cyprus Miami patented land; TNF = USFS Tonto National Forest; BLM = Bureau of Land Management
3. Location in relation to "area of proposed effect" (or facility site)
4. "near:" cultural resource sites adjacent to or within 150 m of the APE

Source: SWCA, Inc., 1995b

areas. Five other sites are within 150 meters of the areas of disturbance and may be affected by modifications to natural processes such as drainage patterns or changes in human use of the area such as traffic patterns or activities ancillary to the mine facilities. Eleven sites are outside the currently identified areas of disturbance. The BL leach pad and Barney waste rock facility contain the majority of the cultural resources, including 21 of the 27 resource sites within the proposed disturbance areas and four of the five sites in proximity to those areas. The GMC leach pad site contains five cultural resource sites and has one close to its boundaries, and the Oxhide leach pad site includes a large portion of an extensive cultural resource site. The proposed action would destroy or seriously impact all cultural resources within the facility disturbance areas. The effect of the loss of these resources would be lessened, and the significant information that these sites can yield would be recovered and made accessible to the general public by the implementation of a carefully designed treatment plan specifying actions for site protection or data recovery.

4.2.7.1 Mitigation Measures and Monitoring

Twenty-seven cultural properties have been identified within the project areas for the proposed leach pads and five others are located close to these project areas. The current evaluations of these properties are preliminary evaluations based only on initial surface inspection. Any treatment plan for these properties needs to begin with site evaluations involving the preparation of brief prehistoric and historic context statements that specify the criteria to be used in the evaluations. Each of the 32 sites should be evaluated using the specified criteria.

Evaluation of prehistoric sites involves limited excavations to establish the nature, extent and integrity of data classes identified in the evaluation criteria. Evaluation of historic sites includes archival and documentary research to establish historic associations and may also include limited archaeological testing to establish whether historic archaeological sites have the potential to yield physical data not available through documentary sources. The evaluations and recommendations must be reviewed and approved by the appropriate state and federal agencies. Consultations with Indian tribes would be conducted during the evaluation of National Register eligibility and the development of appropriate site treatment measures. In those cases where evaluation determines that a site would not be eligible, further treatment would not be necessary.

Site specific treatment plans are based on the results of the evaluations described above. Sites found to be significant that are near the boundaries of the project areas might be avoidable. If this is the case, these sites could be protected by fencing or monitoring of any project activity in the vicinity of the sites. Data recovery plans would be developed for significant sites that cannot be avoided. Data recovery plans for archaeological sites most often include detailed mapping and excavation of selected areas to recover samples of the significant data classes identified in the site. Data recovery plans for historic sites can include additional archival and documentary research, oral history interviews, and engineering or architectural drawings. Implementation of a site specific treatment plan is considered an adequate mitigation measure, but the treatment plan must be based on adequate evaluative investigations, and must be approved by the appropriate agencies under Section 106 of the National Historic Preservation Act.

4.2.8 Socioeconomics

Several issues were raised during scoping concerning the effect the project may have locally and regionally. The issues included:

- Preservation of local jobs,
- Role of mining jobs in the local economy,
- Support of the local economy and the tax base for local services,
- Importance of this project to the copper industry,
- Contribution of this project to the efficient management of the country's copper reserves,
- Preservation of the local mining heritage, and
- Economic effect the project may have on the Phoenix area and the state.

Several evaluation criteria were identified to address potential socioeconomic impacts, including: 1) a change in short-term and long-term employment in primary and secondary jobs, 2) a change in demand for temporary and permanent housing during construction, operation, and closure, 3) changes in annual tax revenues relative to the presence or absence of the project, 4) a change in the economic base on affected areas as they change from recreation and ranching to mining, 5) changes in demand for fuel, equipment, hardware and supplies in the presence or absence of the project, and 6) changes in demand for local public services in the presence or absence of the project.

4.2.8.1 Population and Housing

The expanded leaching operations of the Cyprus Miami Mining Corporation are not expected to require hiring of any additional personnel. Consequently, there is not likely to be any significant direct impact on the population or housing market of Gila County, nor on any of the several communities that exist in the Globe-Miami area.

The Globe-Miami area has experienced a gradual inflow of people (over the last ten years) from other areas seeking better employment opportunities. This has been mainly due to Cyprus Miami and other mining employment. Approval of the Proposed Action is not expected to draw new people to the job market, but is anticipated to support the existing population by preventing loss of jobs. While it is expected that the Globe-Miami area will continue to see growth in home building, this growth is not related to the Cyprus Miami expansion.

The expanded Cyprus Miami leach facility would prevent population decline and recession in the local home building industry in the Globe-Miami area. The prevention of a loss of jobs would also prevent an exodus of population. Maintaining the population would have no adverse impact on the local housing market, the construction industry, or the real estate industry.

4.2.8.2 Environmental Justice

The Proposed Action and alternatives were evaluated for issues relating to the social, cultural, and economic well-being, and health of minorities and low income groups. Such issues are termed environmental justice issues, and none were identified for the Cyprus Miami Leach Facility Expansion Project. Social and economic impacts of the Proposed Action and alternatives would not effect minority or low income groups disproportionately. The No Action alternative could have a disproportionate effect on the Hispanic community because of the high percentage of Hispanic employees.

The currently employed work force has a much higher proportion of persons of Hispanic origin than the overall labor force of Gila County, 43 percent in the Cyprus Miami work force, compared to 17 percent in the county's labor force. The proportion of American Indians in the Cyprus Miami work force, however, is only about half that of the overall labor force in the county, 5 percent in the Cyprus Miami work force, compared to 10 percent in the county's civilian labor force. The share of other racial minorities in the Cyprus Miami work force is the same as that in the county's labor force, 0.5 percent.

4.2.8.3 Employment and Personal Income

Cyprus Miami expects to maintain the employment level of approximately 309 persons at its existing mine operations through development and operation of the proposed expanded leaching facilities for about the next 16 to 20 years. Most of these employees are residents of Gila county.

Total wages and salaries to be paid to Cyprus Miami employees who will keep their jobs as a direct result of the leach facility expansion are expected to average $13,632,000 each year (in 1994 dollars) from 1996 through 2011. It is estimated that the major portion of these personal income payments would go to workers living in the Globe-Miami area. The direct contribution of $13,632,000 per year in personal income to the Gila County economy would make the expanded leach facility responsible for about 4 percent of the basic (imported) personal income received by residents of the county. It would be equivalent to about 12 percent of the personal income of Gila county residents that is directly attributable to the copper industry. The direct impact of the proposed action would be the continued employment of the current employees. There would be no effects on the low-income population of the community.

4.2.8.3.1 Local Purchase of Goods and Services

It is expected that the expanded leach facility would continue to spend over $40.6 million annually for supplies, electricity, fuel, products and services. It is also expected that over $17.3 million would continue to go to suppliers in Gila County. This would amount to $690 million and $294 million, respectively, over the project life. It is expected that more than 40 percent of local purchases ($17,317,000) would go to suppliers located in Gila County because of past experience with Cyprus Miami's purchasing from local suppliers. Virtually all of the remainder would go to suppliers in Maricopa and Pima Counties.

4.2.8.3.2 Direct Displacement of Agriculture

The only displacement to agriculture which is expected to occur relates to grazing of livestock. The anticipated impacts are discussed in Section 4.2.9.3. However, there would be no displacement on Forest Service or BLM lands. The livestock on Cyprus Miami allotments would be moved to other Cyprus Miami land.

It is more probable, however, that the expanded leach facility would displace the grazing activity from the particular land on which it now takes place. If grazing relocations occur, then the business income, personal income, and state and local government revenues derived therefrom could possibly shift to another locale within Gila County. If there are relocations, there would likely be minor losses of agricultural activity but it is not known whether this would affect the net socioeconomic benefits resulting from the expansion of the leach facilities.

4.2.8.3.3 State and Local Taxes Paid Directly

Cyprus Miami would continue to pay over $6 million annually in state and local taxes, or almost $103 million over the life of the project. This would also include severance taxes, property taxes, sales and use taxes, payroll taxes and other taxes and fees.As shown in **Table 4-13**, it also includes about $3,090,000 each year in property taxes, $940,000 in sales and use taxes, $380,000 in payroll taxes, and $274,000 in other taxes and fees to the State and County each year.

4.2.8.3.4 Indirect Impacts on Business Income

Local business firms in Gila County would continue to receive $23 million in direct sales each year as a result of the expanded facilities direct payments of personal, business, and government income, or over $390 million for the project life. The accumulated direct and indirect contributions to business income in the county would amount to $40 million per year, or $680 million for the life of the project.

Business firms throughout the state also would continue to receive nearly $131 million annually as an indirect result of the facility, or $2.2 billion dollars over the project life. The accumulated direct and indirect business income from the continued operation would amount to more than $171 million per year, or $2.9 billion over the project life.

Table 4-13. Total Estimated Economic Effects for 17-year Proposed Action and 10-Year No Action Alternatives

Item	Revenue Projected for Life of Proposed Action	Revenue Projected for Life of No Action
Direct Impact on Arizona Economy	$1,026,500,000	$603,840,000
Purchase of Goods and Services (Arizona)	692,000,000	23,000,000
Direct Impact to Gila County	580,023,000	341,190,000
Personal Income to Gila County	231,000,000	76,500,000
Purchase of Goods & Services in Gila County.	294,389,000	173,170,000
State & Local Tax Revenues:		
State Property Tax	2,200,000	726,000
County Property Tax	21,300,000	7,000,000
School Property Tax	26,600,000	8,800,000
Community College Property Tax	2,100,000	693,000
Other Property Tax	425,000	140,000
Sales Taxes on Purchases	16,100,000	8,800,000
State Payroll Tax	6,500,000	2,100,000
PILT Payments	12,600,000	4,200,000
Severance Taxes	23,800,000	7,800,000
State Taxes and Fees	4,600,000	1,500,000

Source: Leaming 1995.

4.2.8.3.5 Governments Receiving Revenues Directly

Local governments in Gila County would continue to receive a total of $3.1 million annually from property taxes, or $52.7 million over the project life. Gila County, Gila Pueblo Community College and other towns in Gila County would continue to receive more than $1.4 million annually in tax payments, or $23.8 million over the project life. The apportionment of severance and sales taxes paid to the State would continue to be distributed to municipalities and

school districts outside Gila County in the amount of $320,000 per year, or $5.4 million over the project life. The State of Arizona would continue to receive tax payments from property, severance, sales, payroll, and others in the amount of $1.1 million per year or $18.7 million over the project life.

4.2.8.3.6 Indirect Impacts on Personal Income

As the money put directly into the economy by operation of the Cyprus Miami leach facility circulates and recirculates, it creates additional indirect personal, business, and government income in a multiplier effect. The economic multiplier would continue to generate an indirect benefit of almost $10 million each year in addition to the direct personal income of $13,632,000. These accumulated benefits would approach $24.4 million annually or $414 million over the project life.

The indirect impact on the Arizona economy would be even greater. In addition to the $13,632,000 in direct personal income to Arizona residents, the recirculation of the Cyprus Miami contributions to the state economy would create an indirect effect of $42.4 million. Together, this represents a statewide effect of $56.7 million annually, or almost $964 million over the project life.

4.2.8.3.7 Indirect Impacts on Employment

The operation of the expanded leach facility would continue to indirectly support jobs elsewhere in the community. Chapter 3 indicated 540 jobs were indirectly supported in the Globe-Miami area and 1,800 jobs in the state. Combined with the 309 direct employees at Cyprus Miami, that represents a net benefit to Arizona employment of about 2,100 jobs. Continued employment of these persons would be likely to affect the state unemployment rate by about 0.1 percent, thereby keeping it from rising from 5.9 percent in 1994 to 6.0 percent in 1998.

4.2.8.4 Education

Since no significant increase in population in the Globe-Miami area of Gila County is expected as a result of the expanded Cyprus Miami copper producing operations, there is not likely to be any significant increase in the number of school children in the area as a result of those operations. However, the amount of money available to existing school districts, particularly the Miami Unified School District, would increase as a result of the higher tax payments to be made by the Cyprus Miami Mining Corporation on behalf of its expanded leach facilities. That should result in a net positive impact on not only the Miami Unified School District but also on school districts elsewhere in the county and state.

4.2.8.5 Public Safety

Since the Cyprus Miami Leach Facility Expansion Project is not expected to result in any increase in employment but would simply sustain the existing level of employment, there is not

likely to be any increase in demand for public safety and other local government services in the area. The tax revenues from the expanded copper producing operation, however, should provide funds to maintain the existing level of services and maintain existing public infrastructure.

Rural fire districts throughout the county should benefit specifically from the increased money available from the increase in the property tax base in the county created by the presence of the expanded leach facility. This benefit would accrue through property taxes paid to Gila County and distributed to the districts.

4.2.8.6 Health Care and Other Service Sectors

The operation of the Cyprus Miami project is not likely to have any significant adverse impact on local health care facilities in Gila County. Without any additional new workers who are covered by the health care insurance and other typical benefits there would be no effect on the economic base of the local health care industry, positive or negative.

The population stability resulting from employment generated by Cyprus Miami project, combined with the expected direct and indirect benefits in personal, business, and government incomes should continue to stimulate activity in the service sectors of the economy of the Globe-Miami area.

4.2.8.7 Tax Base

Cyprus Miami would continue to make tax payments to Gila County, local school districts, other Gila County school districts, the Town of Miami and Special Districts in Gila County of approximately $3.1 million annually or $53.8 million over the project life. The State of Arizona would continue to receive over $2.8 million annually, much of which would be distributed to other entities across the state. The total tax base which would continue to be provided by the Cyprus Miami expanded leach facility would be $6,054,000 annually, or almost $103 million over the project life. **Table 4-19** summarizes many of the financial benefits discussed in the previous sections. The table also offers a comparison with the No Action alternative.

4.2.8.8 Cumulative Effects

In addition to the direct and indirect contributions of personal, business, and government income to the economies of Gila County and Arizona to be made by the Cyprus Miami leach facility expansion, other economic benefits may be induced in the economy as residents, businesses, and governments react to the continued source of income. The probable retention of population is probably the most significant of those potential induced impacts. An increase in the diversity of businesses within the immediate Globe-Miami economy may also be induced by the income flows coming directly from the continued copper producing operation in the community.

4.2.9 Land Use

Three issues were raised concerning land use and land use changes including:

- potential impacts to grazing, recreation, and other uses in exchange for long-term mining use;
- the potential for long-term public liabilities associated with maintenance of reclaimed facilities on public lands following reclamation and bond release; and
- potential benefits of mining versus other potential uses of the public lands involved.

Two evaluation criteria were identified to address land use issues. First is the project's compatibility or consistency with existing land use plans, regulations, or controls adopted by federal, state, or local governments. Second, is the impact on existing permits or other authorizations and the need for issuance of new permits or authorizations.

The potential for public liability for site reclamation could occur if Cyprus Miami were to go out of business and abandon the site. If that occurred, the Forest Service and BLM would be responsible for reclaiming the site. However, Cyprus Miami has prepared a Reclamation Plan (Golder Associates Inc. 1995a) with estimated costs of $2.83 million. A bond sufficient to provide those reclamation costs will be required to be in place prior to ground disturbance, and the money to complete reclamation would then be available to the Forest Service and BLM if Cyprus Miami forfeited that bond.

The issue raised during scoping concerning the benefits of mining versus other potential uses of the public lands involved is a complex issue. Unless and until the Mining Law of 1872 is amended, this issue is essentially moot. If there are viable copper reserves identified in the area, mining claims will likely be filed. The benefits from mining (the production of copper for world markets, jobs, wages, and tax revenues) are quantifiable. The benefits from the historic land uses in the area are less quantifiable. Livestock operations in the area provide profits to their owners, and those operations also provide a benefit to the U.S. Treasury through grazing fees. Uses of the land for wildlife habitat and recreation are intangible. Of the quantifiable benefits coming from the public lands in the area, mining is providing the largest.

4.2.9.1 Land Use Plans

The study area for land uses consists of approximately 7,560 acres of mostly undisturbed public lands managed by the Forest Service and the BLM adjacent to the existing Cyprus Miami mining operation. The proposed action would not affect land ownership or land status in the study area. Direct impacts to the land use resource would result from the disturbance area required by proposed mine facilities, and from the single use occupancy of the public lands and their closure to the public. The loss of a Forest Service boundary fence would also be a direct impact. Indirect effects to land use may occur in the area surrounding the mine expansion project.

Current land use where the facility sites would be located is primarily grazing. The primary effect of the project on land use would be to convert this land use to mining operations for about 16 to 20 years. Other uses in the area include mining and mineral processing, wildlife habitat, and recreation. The impacts to wildlife are discussed in Section 4.2.6.2. Recreation is not a significant land use of the mining area, as discussed in Chapter 3.

The proposed action would have minor conflicts with the Special Use Permits on National Forest System lands in the study area for the BHP utility corridor right-of-way, grazing permits, and possible road closures. The project would be compatible with Tonto National Forest directives for Management Area 2F, primarily because it is an extension of the existing mining use of the area. The project would be consistent with the Tonto National Forest Land and Resource Management Plan (Forest Service 1985a), which provides for multiple land uses.

The proposed action would conflict with current land uses for grazing, the pipeline right-of-way, and road closures on BLM lands in the study area. The project would be compatible with BLM directives for this area, primarily because it is an extension of the existing mining use of the area.

4.2.9.2 Mining

Mining would remain the predominant land use within the project area during the life of the proposed project. The proposed action would preclude or hinder future mineral development on approximately 1,214 acres to be occupied by the leach facilities and overburden disposal facility. Mineral evaluations conducted on these sites indicated a low potential for economic mineral development.

The potential for public liabilities associated with maintenance of reclaimed leach pads and dumps on public lands following reclamation and bond release was raised as an issue during scoping. There are public liabilities whenever these structures fail or cause maintenance problems on public lands, in that the land management agency must spend funds to remediate the problem. To address this problem, many laws and regulations have been put in place; most prominently the surface management regulations of the Forest Service and the BLM which require mining plans of operation, reclamation plans, and closure plans. The agencies will not approve a project unless they think it can be closed safely. The Clean Water Act requires Corps of Engineers approval of structures that will be placed in drainages. An Arizona Aquifer Protection Permit is required for structures which have the potential to discharge to aquifers, and the permit has a specific closure plan requirement designed to prevent future problems. Finally, Arizona has passed the State Reclamation Act which will require approval of plans for closure of projects on private lands in order to avoid the potential for long-term public liabilities of mine structures after closure. The Cyprus Miami leach facilities expansion project will be in compliance with all these laws and regulations and, as a result, no future, long-term public liabilities associated with maintenance of structures are expected.

4.2.9.3 Livestock Grazing

The analysis areas for impacts to forage resources are the individual grazing allotments on the Forest Service and BLM lands located wholly or partially within the study area. Impacts are analyzed in terms of the removal of acreage from grazing use within each allotment, and the Animal Unit Months (AUMs) for each type of livestock permitted for each allotment.

The proposed action alternative is located within the Bohme and Bellevue Grazing Allotments on Forest Service land, and the Lost Gulch Grazing Allotment on BLM land. The direct impact to grazing resources consists of the acreage which would be closed to grazing for the duration of mine operations. The acreage which would be disturbed in each grazing allotment located on Forest Service and BLM lands is summarized in **Table 4-14**.

The Bohme Grazing Allotment totals 5,740 acres, and is permitted for 1,186 Animal Unit Months (AUMs). The proposed action would affect 254 acres, or 4.4 percent of the Bohme Allotment, as summarized in **Table 4-14**. However, the permitted numbers of AUMs would not be reduced because the reduction in area is considered minor. Cyprus Miami Mining Corporation is the only permittee on the allotment.

An estimated 244 acres, or about 1.4 percent of the total of 17,539 acres of the Bellevue Grazing Allotment, would be disturbed by the Oxhide Leach Pad facility. The permitted numbers of AUMs were reduced by 25 percent in 1995. No further reductions would be made as a result of this action. There are three permittees on the allotment.

The proposed project facilities would affect 390 acres of the 9,894 acre Lost Gulch Allotment, the permitted AUMs would not be reduced. Most lands in the allotment are Cyprus Miami-owned lands occupied by existing mining operations.

Portions of the leach pads and the Barney overburden facility would be permanently lost to livestock grazing. Steep slopes remaining after reclamation would not be suitable for use by livestock. Of the 888 acres of disturbance in the allotments, approximately 785 acres would be permanently lost to grazing.

Table 4-14. Acres of Disturbance in Grazing Allotments

Project Component	Total Facility	BLM	Tonto National Forest		Total Disturbance in Grazing Allotments
		Lost Gulch	Bohme	Bellevue	
Oxhide Leach Facility	281	47	20	244	281
BL Leach Facility	477	174	218	0	392
GMC Facility	296	152	0	0	152
Barney Overburden	161	47	16	0	63
Totals	1,214	390	254	244	888

Source: Golder Associates, Inc., 1995a
USDA Forest Service, 1995

Impacts to grazing improvements would involve the displacement of fences and loss of stockponds by proposed facilities. Fences are located along the boundaries between grazing allotments, Forest Service and other lands, or between pastures. In the Bellevue Allotment, two miles of allotment boundary and Forest Service boundary fences would be displaced by the Oxhide leach pad facility. Three ponds at the Oxhide facility and three at the BL facility would be lost.

In the Bohme Allotment, several sections of fence would be displaced by project facilities. About 3.5 miles of Forest Service boundary fence and one-half mile of fence around the Bohme headquarters would be displaced by the BL leach facility. The Buckhorn Spring and Unnamed Tank (aka Frog Tank) would also be displaced by the BL leach facility. No other grazing improvements in the Bohme, Bellevue, or Sleeping Beauty allotments on Forest Service lands would be affected. Most of the tanks and springs utilized by cattle in the vicinity are located upstream of any project activity.

On BLM lands, several grazing improvements in the Lost Gulch Allotment would be affected by the BL leach facility. These include the Vigor of Life Spring and the Upper, Middle, and Lower Webster Tanks. The Schultze Tank is located on the margin of the Upper Oxhide pit. A site visit to evaluate several pond and tank sites (October 11, 1995) was unable to locate Schultze Tank, and it was determined that the tank probably was outside the footprint of the leach facility site.

4.2.9.4 Public Access

The availability of access to public lands is directly related to the public's ability to utilize those lands. The analysis area for project impacts is the study area. The following criteria were used to identify effects to public access: (1) change in public access on existing roads, (2) project-related changes that affect duration, quantity, and type of impact to public access.

Public access to the proposed facility sites is quite restricted, as the sites are adjacent to existing mining operations, and over the past decades, many local roads(FS and BLM) which formerly traversed the site have been closed. Access is from the west on Forest Road 608 into Little Pinto Canyon. Access to the Oxhide facility would likely be from the east from Cyprus Miami property. The BL leach facilities and the Barney overburden site would be accessed from existing roads located north, south, and west of the study area, including the Little Pinto Canyon road. Access to the GMC facility would be from existing primitive roads located north of the study area.

Public access into the study area from the west is from Castle Dome Road (Forest Roads 287 and 287B), which provides access from Highway 60 west of the town of Miami to both the project area and BHP's Pinto Valley Mine. Extending east from Forest Road 287B is Forest Road 608 along Little Pinto Canyon. This road currently provides access to some existing Cyprus Miami facilities and to the Cyprus Diamante Ranch, which borders the Cyprus Miami mine property and is gated and locked at the private land boundary. The road is not generally accessed by the public, although a small number of recreationists do use the road. The road would be closed to public access for the duration of mining activities. Following closure, it would become either a private, permitted road or the FS may abandon it.

The Little Pinto Canyon road would be rerouted around the proposed BL Leach facility and the adjacent fresh water impoundment. Over one mile of road would be relocated to the south perimeter of the facility. The road would be gated west of the fresh water impoundment to restrict public access to the project area. Road construction, the road closure, and gate installation would be coordinated with the Forest Service.

After mining operations cease and final reclamation is completed, the affected public lands would be reopened to public access. Primitive roads into the mining areas would remain closed and vehicular access would be restricted in areas that cannot practically be made safe by means of earthen berms or other methods. Final access road configurations would be subject to review by the Forest Service, but only Forest Road 287B is expected to retain its original configuration.

4.2.9.5 Transportation

Transportation issues included potential impacts to traffic flow and safety on local highways, impacts to existing roads and trails within the project area, and changes in operating levels of service as a result of project generated traffic.

Transportation effects have been evaluated relative to four criteria: (1) increase in Average Daily Traffic (ADT) counts on access routes; (2) compliance with applicable levels of service (LOS) criteria; (3) protection of safety conditions for the traveling public; and (4) the number of miles of roads and trails which would be removed from public access.

4.2.9.5.1 Traffic Volumes and Levels of Service

Traffic volume increases associated with the proposed action would be minimal, if any. No effects on operating LOS are expected as a direct result of the project. Since the proposed action would result in the continuation of leaching operations located at existing facilities, the current traffic volumes and trip generation at the mine are expected to remain constant. In addition, employment levels would also remain at existing levels and no significant increase in employee-generated traffic would result. Additionally, the project does not involve actions requiring new transport of materials to or from the mine. Therefore, since the project does not involve changes, additions, or actions which would likely affect traffic or circulation, existing LOS and operating conditions on U.S. Highway 60 and other study area roadways in the Globe-Miami area would not be affected by the proposed action.

4.2.9.5.2 Traffic Safety

The proposed project is not expected to change the mix of heavy vehicles in the traffic stream or to cause any adverse changes to highway traffic and safety in the vicinity. The risk of traffic accidents involving project-related vehicles would remain similar to current levels as described in Section 3.11. Potential impacts associated with the handling of hazardous materials are addressed in Section 4.2.11.

Forest Service Road Management

Only one designated Forest Service road is contained within the project area (Road 608 in Little Pinto Canyon) and would be closed for public use. Although no usage records are maintained by the Forest Service, the area is known to receive a minimal amount of public recreational use. The majority of land east of the Tonto National Forest boundary in this area is privately owned. According to the Resource Access Travel Management Plan, most of the primitive roads near the west side of the project area have been identified for closure (Herkenhoff 1995b).

4.2.9.6 Cumulative Effects

The study area for cumulative effects is the Miami mining area consisting of the Cyprus Miami study area, BHP Copper, Inc.-controlled lands, BHP's Pinto Valley Mine, and adjacent lands managed by the Forest Service and BLM. The existing mining disturbance from current operations in the Miami mining area totals 13,190 acres. The cumulative incremental effect of the Proposed Action would add 1,057 acres of disturbance. Historic land uses such as grazing and recreation have not been available in the mining disturbancearea. Once mining operations have ceased and public access is reopened, the historic land uses of grazing wildlife habitat and recreation should resume in some of the areas that were closed for public safety. There would be long-term loss of grazing lands on approximately 785 acres. Forest Road 608 would be closed for the duration of the project. There would be no effects on Forest Road 287A, which provided access to the Pinto Valley mine, or any other road used for public access.

4.2.9.7 Mitigation Measures and Monitoring

Forest Service-maintained fences between allotments would need to be diverted around the facility sites and rebuilt in order to separate the allotments prior to surface disturbance. Planned reclamation activities would return a portion of the disturbed areas to grazing, wildlife habitat, and recreation uses. Wildlife habitat requires sources of water and fairly large contiguous areas which are naturally or artificially vegetated with desert chaparral plant associations. The post-mining topography should supply similar diverse terrain.

Mitigation measures can minimize impacts related to access on Forest roads. Road construction or use should not prevent nor unreasonably disrupt the use of existing public roads for recreation access. Public land access would be regulated only to facilitate mining operations and protect the public from hazards associated with the mining project. Impacts to transportation would be mitigated by review by the Forest Service and BLM of all road closure requests by Cyprus Miami prior to the initiation of project activity.

4.2.10 Visual Resources

The single issue raised concerning visual resources was the potential for visual intrusion by the leach pads and overburden area to three sensitive viewpoints, Top-of-the-World, along US Highway 60, and along Arizona Highway 88 (see **Figures 3-17, 3-18, and 3-19**, respectively). The evaluation criterion for this issue is to identify sensitive viewpoints and compare the expected visual changes to the visual quality objectives (VQO) for lands administered by the Tonto National Forest Land and Resource Management Plan (LRMP) and also to apply these criteria to the lands administered by the Bureau of Land Management.

The project area for direct and indirect impacts in the visual resource analysis consists of the proposed disturbance areas and the adjacent lands. The Miami mining area is the study area for cumulative impacts to visual resources.

The proposed project impacts, even though major in scope, when put in context and scale with the existing surrounding landscape, are not considered significant. The Proposed Action alternative would impact the study area's visual resources. These impacts may be lessened with proposed reclamation measures. The reclamation measures of recontouring and revegetation will help soften color and lines.

4.2.10.1 Visual Resource Management

All of the proposed facilities are located in the background distance of zones classified as Marginally Acceptable with the exception of the Oxhide facility, which is located in the middleground distance classified with Modification and Partial Retention VQOs.

Table 4-15 summarizes the locations and acreage of the proposed facilities affecting various VQO classifications. The acreage represents changes in visual quality. (Refer to the VQO map shown in **Figure 3-16** when studying the table.) These disturbances represent a small percentage of change in the overall acreage of this management area.

Table 4-15. VQO Classification Acreage Potentially Affected

Facility	Modification	Partial Retention	Marginally Acceptable
Oxhide	244	27	0
Barney	0	0	64
BL	0	0	284
GMC	0	0	4
TOTAL	244	27	352

4.2.10.2 Visibility of Project Facilities

The proposed project's visual impact is assessed from locations where there is potential of a significant number of people viewing the area. The study area is visible primarily from U.S. Highway 60 at the Oxhide Pit Gate, from U.S. Highway 60 east of Arizona Highway 88, and Castle Dome Road (Forest Road 267B). A site visit indicated that project facilities are located in a topographic low which forms a bowl surrounded by large rolling hills. The proposed facilities would not be visible outside the bowl and, therefore, a "seen area" analysis was not conducted.

Most of the proposed facilities are isolated from viewers driving U.S Highway 60. Their view is screened by the rugged topography, oak chaparral, and other vegetation. In addition, the proposed facilities would be in an area with existing major mining disturbance from historic and existing mining operations. The proposed facilities would attract little viewer attention and would not dominate the landscape as viewed from the road. The landscape's existing character would remain unchanged as seen from any point along U.S. Highway 60. Rugged topography would screen the proposed Oxhide facility from most viewpoints along the highway. The site would not be visible from the key viewpoint at the gate along Highway 60, as the existing facilities' topography adjacent to the road blocks the view. Additionally, vehicles passing the key observation point at normal speeds would have less than a second to view the facility before the topography would again block the view.

Viewers at the key observation point on Highway 60 east of Highway 88 might be able to see the location of the proposed facilities, but they would be unable to distinguish the specific facilities from the surrounding areas (see **Figures 3-18 and 3-19**).

The only area where the proposed facilities would be visible in the foreground is Castle Dome Road (Forest Road 287B), which provides access to the western side of the project area and to BHP's Pinto Valley Mine. The road does not receive high usage and the existing traffic consists largely of employees of the Pinto Valley mine. Also, the duration of time that the facilities would be visible to drivers on the road would be brief. From the Castle Dome Road, viewers would be able to glimpse portions of the Oxhide and BL facilities.

Public questions were raised regarding visibility of the project area from Top-of-the-World, a residential area about four miles west of the proposed facilities. The view from Top-of-the-World does not include any portion of the project area (**Figure 3-17**). Intervening topography and vegetation prevent views of the proposed project area. The approximate disturbance of 1,057 acres, resulting from the proposed facilities, would not be visible from this observation viewpoint.

Visual resource impacts in the project area do not meet the assigned VQOs, but are not visually prominent in the characteristic landscape. The scale and magnitude of the impacts decrease when put in context with the surrounding Miami mining area and its historically modified landscape, resulting in it becoming part of the modified, culturally accepted landscape.

4.2.10.3 Cumulative Effects

The project area for cumulative effects is the Miami mining area north of Highway 60. This area consists of the Cyprus Miami project area, BHP Copper, Inc.-controlled lands, BHP's Pinto Valley Mine, and adjacent lands managed by the Forest Service and BLM. The visual effects of mining activity has been part of the characteristic landscape since the 1870s. The existing mining disturbance from current and past operations totals approximately 13,190 acres. The proposed project would increase the disturbance by approximately 8 percent to 14,404 acres and constitute a relatively minor part of the total area utilized for mining operations. Adding the proposed Carlota project would make total area disturbance of 15,454 acres.

4.2.10.4 Mitigation Measures and Monitoring

Final reclamation and mitigation measures recommended for other resources, such as vegetation and wildlife, would reduce color and texture contrasts, and lessen landform modifications. Any major landform changes would be a permanent alteration of the characteristic landscape, however landform modification would include contouring to blend the facilities with the surrounding landscape somewhat.

4.2.11 Hazardous Materials

Important issues related to hazardous materials at the expansion site are related to the potential impacts to the environment in the event of a release of the materials. During the on-site transportation, use, or storage of these materials, accidental releases could occur. Evaluation

of the impacts of these materials being released is related to the potential of the spill to impact a sensitive receptor.

Direct or indirect effects of a release of sulfuric acid or leach solutions to the environment in an uncontrolled manner could include stressed or killed vegetation, contaminated soils, and contaminated surface water. These effects would depend on the amount of the substance released, the location of the release, and the time of the release. Since the leach facility expansion project would not require any more storage volume for acid and only the addition of associated piping and lined leach solution collection ponds, the evaluation of spill potential is based upon new solution transfer facilities only.

All three leach facilities would have leachate solution reservoirs constructed at the toe of the ore heap. The reservoirs would be double lined. Leachate solutions would leave the reservoirs in high density polyethylene pipes which would connect with existing leachate handling facilities or the solvent-extraction plant. Some of the transfer piping would be constructed in trapezoidal ditches or within the road and berm profile. Lengths of new transfer piping required for the proposed facilities are shown in **Table 4-16**

Table 4-16. Lengths of New Solution Transfer Piping

Oxhide Facility	2,400 feet of new piping
BL Facility	4,800 feet of new piping
GMC Facility	8,800 feet plus 3,000 feet of transfer channel

Piping and transport systems for the acid would be engineered and maintained to prevent a spill from these systems. Any acid spilled would be considered hazardous if the pH is below 2.0. This waste material would then have to be handled in a manner consistent with CERCLA regulations (40 CFR 300).

In the event of a spill, Cyprus has prepared plans for the response that includes (1) emergency measures and immediate mitigation measures, (2) notification and containment procedures, (3) waste handling and disposal procedures, and (4) inspection and record keeping procedures. If a reported quantity of a hazardous material is released, the spill is reported as required to the National Response Commission, State Emergency Response Commission, and Local Emergency Planning Commission. The spill is investigated and cleaned up and necessary repairs are made in accordance with Cyprus Miami's Spill Prevention, Control, and Countermeasures Plan (SPCC)(Cyprus Miami 1993).

4.2.11.1 Cumulative Effects

Large-scale mining operations occur in the surrounding area, all of which utilize similar constituents in their processes. Addition of the piping to the leach pads, inclusive of the containment and spill control measures, would add to the possibility of a release, but by only a minor amount (0.5 percent). Although a release may occur, the measures are in place for an

appropriate response to this event, and appropriate containment would be installed with this additional piping. These measures would minimize the possible cumulative effects of the storage and use of sulfuric acid and leach solutions associated with the project expansion. Because old, unlined leach pads would be phased out as the new pads come on line, no cumulative effect is anticipated.

4.2.11.2 Mitigation Measures and Monitoring

With the addition of the piping required for expansion of pumps, trenches, and the piping required for expansion of the leach facilities, additional monitoring procedures would be necessary. Lines and connections utilized in the transportation of the sulfuric acid are inspected daily for leaks or breaks. Pipelines also have pressure monitors which detect sudden pressure losses and send an alarm to the control room at the SX plant. The control room is staffed 24 hours per day. These measures serve to minimize the potential for any spills to the environment. All spills would be treated in accordance with the procedures in the approved NPDES permit for the existing facilities. The existing SPCC Plan would be modified to address the new facilities. The SPCC Plan requires notification of all spills which leave a containment area. No additional mitigation measures are proposed.

4.3 ALTERNATIVE A - MODIFIED DEVELOPMENT SEQUENCE (AGENCY PREFERRED)

This section identifies the potential environmental consequences of implementing a modified version of the Proposed Action. The Proposed Action and Alternative A are essentially identical, with the exception of the sequence of construction of new facilities (see **Figure 2-2**). Under this alternative, the order of construction for the GMC leach facility and the Oxhide leach facility would be reversed. The impacts of this alternative are identical to the proposed action except for certain resources, as indicated in **Table 4-17**. The discussions that follow address the differences in impacts between this Alternative and the Proposed Action for only those resources where such differences occur.

4.3.1 Air Resources

Alternative A, the agency-preferred alternative, would also be a continuation and expansion of the existing operations. However, the sequence of construction of facilities would be different. The BL leach pad and the Barney waste rock deposition area would be constructed in 1997, the GMC pad by 2000, and the Oxhide pad by 2009. This means haul roads and areas of operation would differ in operation from the Proposed Action. This alternative was evaluated against the same impact criteria identified in section 4.1.1.

Table 4-17. Impacts of Alternative A Compared to the Proposed Action

Section	Resource	Alternative A Differences
4.3.1	Air Resources	Alternative A would have fewer emissions of PM_{10}, NO_x, and SO_2 than the Proposed Action. The alternative also would have fewer emissions than the No Action alternative (see **Table 4-2** and **Table 4-3**).
	Geology and Minerals	No differences
4.3.2	Groundwater	Only difference is when or if the potential impacts would occur from development of the Oxhide facility and how the potential impacts could be reduced. New technology may arrive or the regulatory status of Webster Lake might change during the seven year delay for the Oxhide facility. These could further delay or eliminate the need for the Oxhide facility.
4.3.3	Surface Water	Potential impacts at the Oxhide facility would either be delayed or eliminated. Potential loss of three ponds and a seep would be delayed seven years. If the former Webster lake site becomes available for use, impacts at the Oxhide facility would be reduced, or not occur.
	Soils	No differences
4.3.4.1	Vegetation	Loss of 1.56 acres of wetland habitat would be delayed seven years.
4.3.4.2	Wildlife	Disturbance of the longfin dace population at the Oxhide site and some individual lowland leopard frogs would be delayed seven years.
	Cultural Resources	No differences.
	Socioeconomics	No differences.
4.3.5	Land Use	Grazing in the Lost Gulch allotment would be affected earlier and the Bellevue allotment later. Forest Service boundary fence not disturbed for seven years.
4.3.6	Visual Resources	Alternative A was shown by modeling that it would not have any effect on visibility in the Superstition Wilderness, while the Proposed Action was expected to affect visibility.
	Hazardous Materials	No differences.

4.3.1.1 Emissions

4.3.1.1.1 Fugitive PM_{10}

Under Alternative A, Cyprus Miami would expect to maintain the mining rate near the 1995 mining rate of 95.7 million tons of ore and waste rock during 1996 and 1997. Production would

decrease slightly in 1998 and 1999, and peak at 96.0 million tons in 2000 when construction of the GMC leach pad is completed. Production would then be relatively constant at 91.2 million tons per year until the end of the life of the mine plan in 2011. The annual mining rate would be at a maximum in 2000.

The annual emissions for Alternative A are shown on **Figure 4-2** for the life of the mine. The peak annual emissions (controlled emissions) would not occur until 2007. Peak emissions would result from vehicles associated with hauling ore and waste rock to various locations in the mine. The maximum PM_{10} emissions in 2007 would be 3,636 tons per year. Most of these emissions would occur from Cyprus Miami lands that are currently permitted. Only 228 tons per year, or 5.1 percent of the total emissions, would occur from new mining activities on previously non-permitted federal lands. Generally, the emissions from the federal lands would constitute about five to ten percent of the total emissions during each mining year.

The net maximum PM_{10} emissions in 2007 would be 140 tons per year less than the maximum emissions year of the No Action Alternative, based on 70 percent control efficiency. Therefore, the maximum annual air quality impacts of Alternative A would be a net deficit compared to those that would occur if the expansion project is not approved (the No Action Alternative).

4.3.1.1.2 Nitrogen Oxide Emissions

NO_x emissions from diesel fuel combustion and blasting activities would be 152 tons per year less than the maximum emissions under the No Action Alternative. This would be largely a result of reduced haul distances. Therefore, no additional air quality impacts would result from NO_x emissions under Alternative A.

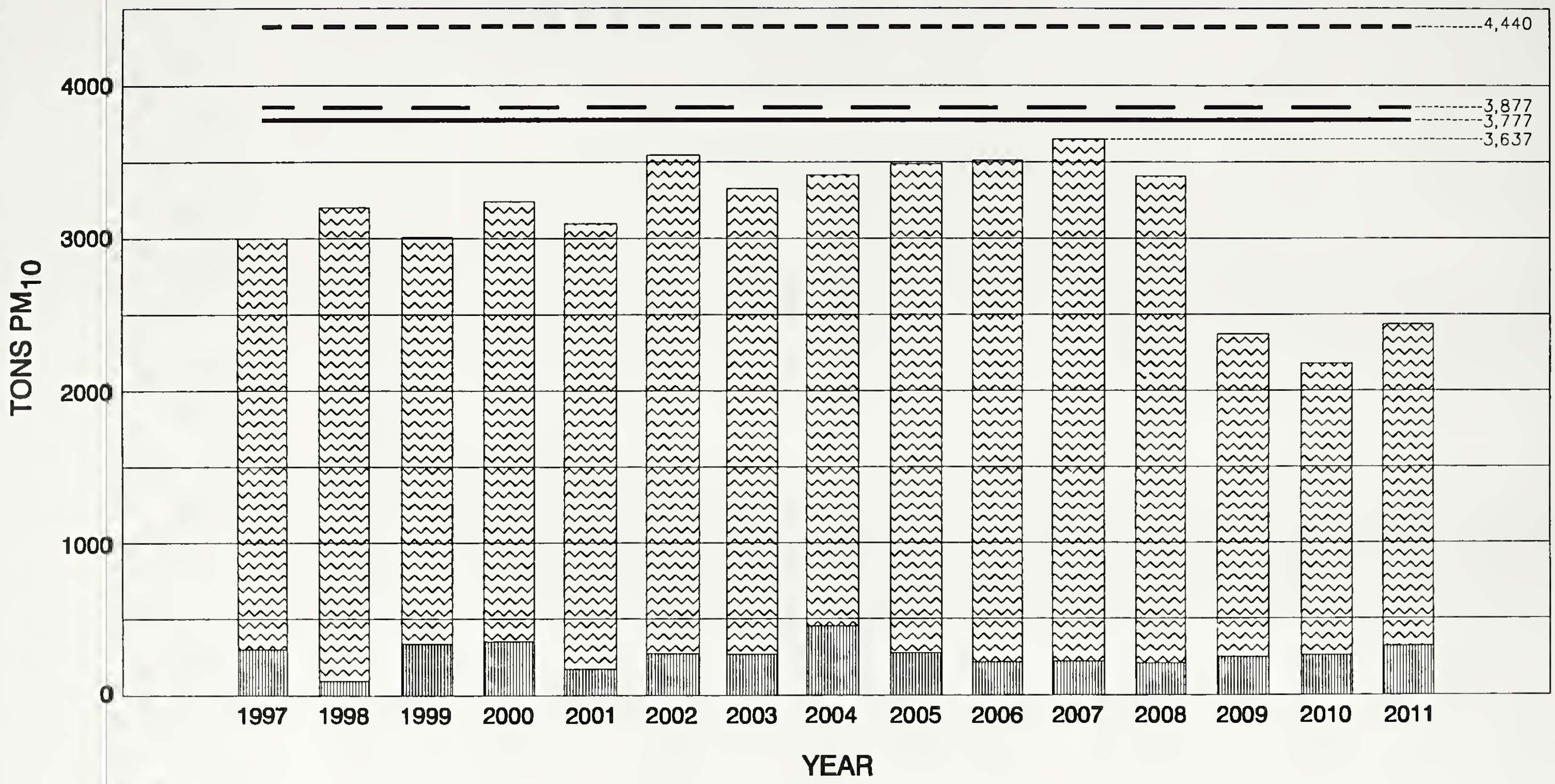
4.3.1.1.3 Sulfur Dioxide Emissions

SO_2 emissions would be the same as under the Proposed Action or No Action Alternatives if the EW tankhouse boiler was converted to operate using No. 2 diesel fuel oil if an emergency situation interrupted the supply of natural gas. SO_2 emissions resulting from diesel fuel combustion and blasting activities would be 13 tons per year less than the maximum emissions under the No Action Alternative as a result of fewer haul truck miles driven. Therefore, no additional air quality impacts would result from SO_2 emissions under Alternative A.

4.3.1.1.4 Volatile Organic Compound (VOC) and Hazardous Air Pollutant Emissions (HAPS)

Hazardous air pollutant emissions would be the same as under the Proposed Action Alternative and 1.4 percent higher than the No Action Alternative (3.35 tons per year).

VOC emissions under Alternative A would be identical to the No Action Alternative with one exception: the small VOC emissions from diesel storage tanks would be slightly lower. The



de minimis Level Requiring Conformity Determination (100 tpy above existing conditions or No Action)

No Action (maximum year 2000)

Proposed Action (maximum year 2005)

Alternative A (existing disturbance non-facility sites)

Alternative A (new facility sites on federal lands)

Refer to Tables 4-2 and 4-3

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Figure 4-2

PM-10 EMISSIONS FOR PROJECT ALTERNATIVES

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maximum amount of annual diesel fuel usage for Alternative A would be 13.9 million gallons. Diesel fuel consumption in 1993 was 7,995,750 gallons and VOC emissions from the storage tanks were 0.07 tons per year. Scaling up these 1993 emissions to the maximum emissions in 2000 yields 0.12 tons per year [(13,900,000/7,995,750) x 0.07].

4.3.1.1.5 Sulfuric Acid Mist Emissions

Sulfuric acid mist emissions would be the same as under the Proposed Action

4.3.1.2 Conformity Determination

The Conformity rules allow for the use of the "net emissions" approach. 58 FR No.228, page 63243 states "The final rule is revised to clarify that the total direct and indirect emissions may be a 'net emissions' calculation." The Conformity requirements for applicability and analysis generally do not include reasonably foreseeable projects other than those caused by the federal action. Thus, the calculation of emissions for de minimis or offset purposes includes only the net direct and indirect emissions caused by the Federal action in question. Further, the final definition makes it clear that the portion of emissions which are exempt or presumed to conform under 40 CFR 51.852 are not included in the total of direct and indirect emissions. In 40 CFR 51.852, it states: "Caused by, as used in the terms "direct emissions" and "indirect emissions" means emissions that would not otherwise occur in the absence of the federal action." In the case of the Cyprus Miami Leach Facilities Expansion Project, those emissions that would not occur in the absence of the federal action are one and the same and equal to the emissions that would occur from the No Action Alternative previously described.

Under the agency preferred Alternative A, the annual PM_{10} and SO_2 emissions would fall below de minimis levels. With Alternative A, there would be a net reduction from the No Action Alternative emissions level. This situation is illustrated in **Figure 4-2** where the heavy black line represents 3,777 tons per year in the year 2000 for the No Action Alternative, and which is higher than the worse case year for Alternative A (2007). A full conformity determination would be needed if annual emissions from Alternative A exceeded the de minimis level represented by the dotted line in **Figure 4-2** (100 tons per year above the No Action level).

The electrowinning tankhouse at Cyprus Miami is physically limited in its capacity to an annual production level of 210 million pounds of copper cathode. To go beyond this level would require modification of the existing facilities and would trigger the air quality permit revision process at the ADEQ.

The mine operation presently waters roads at a control efficiency rate of 70 percent and this rate is sufficient to prevent exceedance of the conformity threshold up to an annual production level of 170 million pounds of cathode copper. If this production level were exceeded, the control efficiency would need to be increased in order to prevent an exceedance of the conformity de minimis threshold. The control efficiency levels are shown in the following:

Production (million lbs copper)	Required Control Efficiency (percent)
170	70
180	72
190	73
200	74
210	76

A requirement for increased control efficiency and subsequent increase in water application will be added to Cyprus Miami's mine dust control plan. This dust control plan is an enforceable requirement of the ADEQ air quality operating permit. The dust control plan will also be included in Cyprus Miami's Forest Service and BLM Operating Plan.

Records of production levels are maintained by Cyprus Miami. If EW copper production is projected to exceed 160 million pounds of cathode copper during a 12-month production cycle, watering efficiency will be adjusted in accordance with the above table which will be included in Cyprus Miami's mine dust control plan.

4.3.1.3 Visibility Impacts to Superstition Wilderness

The emissions inventory presented in **Table 4-2** shows that maximum annual PM_{10} emissions under Alternative A would be 140 tons per year less than the No Action Alternative. The NO_x and SO_2 emissions, shown on **Table 4-3**, would be 152 and 13 tons per year less, respectively, than the No Action Alternative.

Although total emissions under Alternative A would be less than the No Action Alternative, some of the sources of the emissions would be slightly closer to the nearest boundary of the Superstition Wilderness. **Table 4-18** summarizes the distances to the Superstition Wilderness for the existing mining operations and those proposed for both the Proposed Action and Alternative A. Since the net effect of varying the source distance was uncertain, a Level 2 visibility analysis was conducted. A Level 2 analysis uses meteorological data collected on site to compute the wind speed and stability classification which has a cumulative frequency of occurrence of one percent. In other words, meteorological conditions are selected such that more adverse conditions occur only one percent of the time.

Table 4-18. Distances From Cyprus Miami Facilities to Closest Superstition Wilderness Boundary

No Action Plan		Proposed Action		Alternative A	
Destination of Waste Rock or Ore per Mine Plan	Distance to Wilderness Area (miles)	Destination of Waste Rock or Ore per Mine Plan	Distance to Wilderness Area (miles)	Destination of Waste Rock or Ore per Mine Plan	Distance to Wilderness Area (miles)
27-28 Leach Dump	8.1	27-28 Leach Dump	8.1	27-28 Leach Dump	9.4
34-35 Leach Dump	8.1	34-35 Leach Dump	9.0	34-35 Leach Dump	9.0
22 Dump	7.8	40 Leach Dump	7.5	BL Facility	7.7
Barney Waste Rock	7.6	BL Facility	7.7	GMC Facility	9.0
TJ Pit	9.5	GMC Facility	9.0	Oxhide Facility	7.5
Bluebird Pit	8.6	Oxhide Facility	7.5	22 Dump	7.7
Oxhide Pit	7.9	22 Dump	7.6	Barney Waste Rock	7.6
		Barney Waste Rock	7.6	TJ Pit	9.5
		TJ Pit	9.0	Oxhide Pit	7.9
		Bluebird Pit	9.0	31 Dump	9.4
		Oxhide Pit	7.6	94 Dump	9.4
		31 Dump	8.1	GMC Foundation	9.0
		94 Dump	8.1	Oxhide Foundation	7.5
		GMC Foundation	9.0	BL Foundation	7.7
		Oxhide Foundation	7.6		
		BL Foundation	7.7		
Average Distance to the Superstition Wilderness Area Boundary	8.4 miles		8.3 miles		8.3 miles

Destinations shown on **Figure 2-1**.

4.3.1.3.1 Visibility Model Results

The VISCREEN visibility model was used to evaluate the potential visibility effects on the Superstition Wilderness under Alternative A. VISCREEN indicates whether the emission source would adversely affect the Class I area visibility or not.

The Level 1 analysis using the worst case meteorology indicated that Alternative A might have a visual impact in the Superstition Wilderness. Therefore, the Cyprus Miami meteorological data, described in Chapter 3, were used to provide the wind and stability combination for the Level 2 analysis. The Level 2 analysis was conducted according to the EPA Workbook for Plume Visual Impact and Analysis (Revised) (U.S. EPA 1992). Wind directions from the northeast to the southeast were used because pollutants could only be transported to the Superstition Wilderness with a wind blowing from these directions. Based on the data set, these wind directions would only occur 21 percent of the time on an annual basis. To be conservative, only stability classes D, E and F were used because the more unstable classifications, A, B and C would permit more vertical and horizontal dispersion. For similar reasons, wind speeds above 8 meters per second were not included because these speeds would produce much more horizontal dispersion of the pollutants. The one percent occurrence was a wind speed of two meters per second and a stability class D. Because of the presence of intervening terrain between Cyprus Miami and the Superstition Wilderness, the stability was raised to a C classification to compensate for turbulence not accounted for on the model induced by complex terrain between the Cyprus Miami facilities and the Superstition Wilderness boundary.

The model was run using 228 tons per year of PM_{10} and 193 tons per year of NO_x emissions from the facility sites on Federal lands (the Federal footprint). The emissions from the Federal footprint were assumed to originate from the center of the proposed BL Leach facility. The visual impact was modeled by placing a hypothetical observer at the nearest boundary (12.4 km) of the Superstition Wilderness (**Figure 4-3**). The model then transports the plume toward the observer and calculates any visual impact for viewing angles every five degrees around the hypothetical observer.

The results of the VISCREEN Level 2 analysis show that visibility would not be impacted from a view at the Wilderness boundary looking into the Wilderness. The intervening high terrain between the Cyprus Miami mine and the Superstition Wilderness would further minimize any visibility impact

4.3.1.3.2 Other Air Quality Related Values (AQRV)

The only other AQRVs identified for the Superstition Wilderness besides visibility, were terrestrial and aquatic resources. Since Alternative A showed a net deficit in emissions relative to the No Action alternative, it was determined there would be no effect on other AQRVs in the Superstition Wilderness.

4.3.1.4 Cumulative Effects

It was determined that Alternative A would not contribute to cumulative effects as a result of having a net deficit in emissions relative to the No Action Alternative.

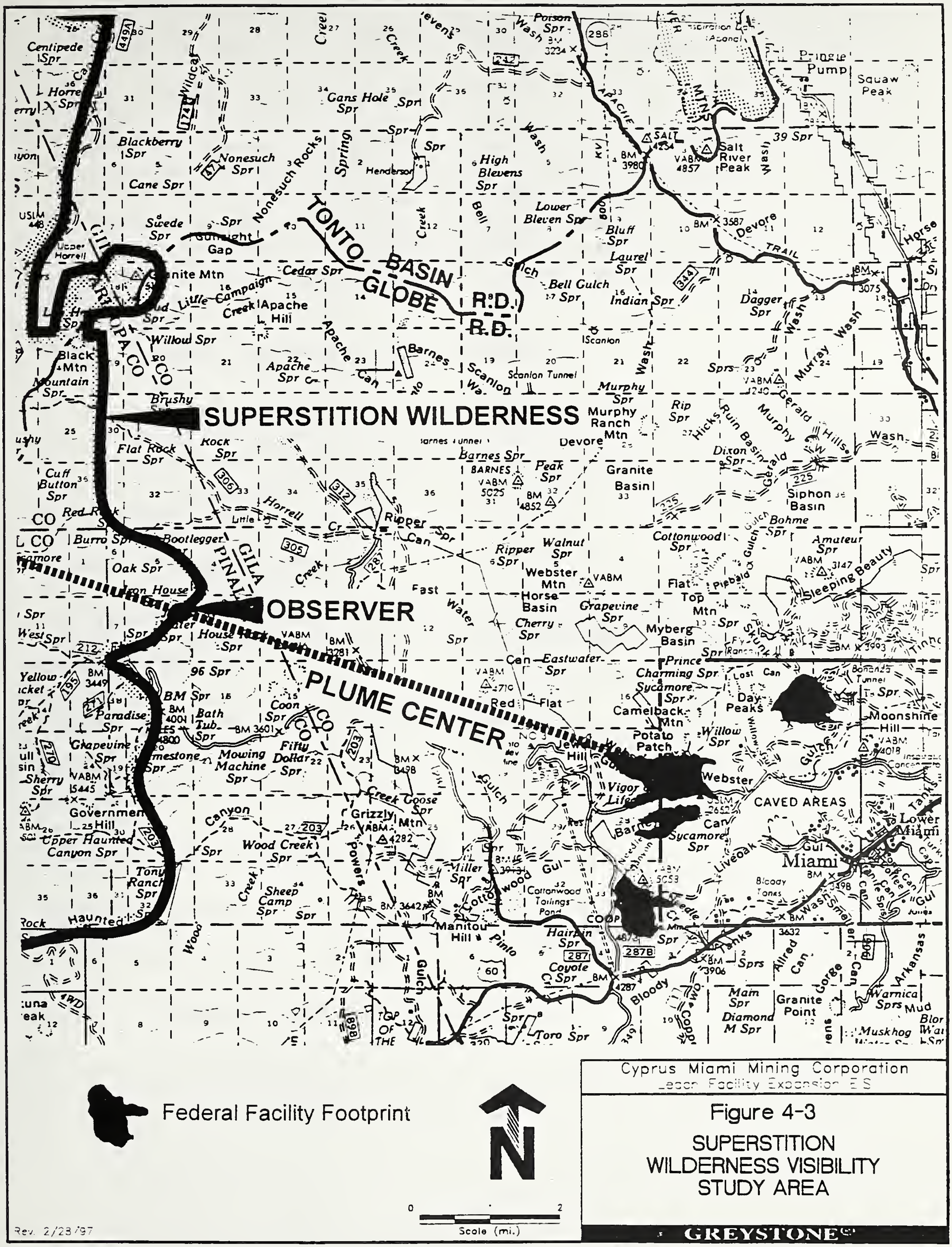

Figure 4-3
SUPERSTITION WILDERNESS VISIBILITY STUDY AREA

4.3.1.5 Mitigation Measures and Monitoring

The existing monitoring stations described in Section 3.1.1.2 would continue to be operated as is, or as modified by the ADEQ, during the life of the project. Mitigation measures described in Section 4.1.1.2 would continue. Mitigation measures that yield 70 percent control of fugitive dust would be maintained. Cyprus Miami has committed to further discussion and involvement in monitoring air quality in the Superstition Wilderness. No further mitigation is proposed for production levels up to 160 million pounds of cathode copper annually. See discussion in Section 4.3.1.2.

4.3.2 Water Resources - Groundwater

Impacts from Alternative A would be the same as described for the Proposed Action, in Section 4.2.3. The order of construction of the leach facilities (Alternative A constructs the Oxhide facility last) does not change the potential impacts to groundwater. However, if Alternative A results in the Oxhide facility not being constructed, then no impacts to groundwater would occur in that localized area.

4.3.2.1 Cumulative Effects

No further cumulative impacts were identified as a result of Alternative A. Cumulative effects would occur to groundwater quantity in the regional aquifer due to extended life of pumping to dewater the mine pits.

4.3.2.2 Mitigation Measures and Monitoring

Mitigation and monitoring for Alternative A is the same as for the Proposed Action (section 4.2.3.4).

4.3.3 Water Resources - Surface Water

Impacts from Alternative A would be the same as those described for the Proposed Action in Sections 4.2.4.1, 4.2.4.2, 4.2.4.3, and 4.2.4.4. Under this alternative, impacts to the Oxhide wetland would be delayed seven years.

4.3.3.1 Mitigation Measures and Monitoring

Mitigation and monitoring for Alternative A are the same as for the Proposed Action in Section 4.2.4.5. However, if Alternative A results in the Oxhide facility not being constructed, then mitigation measures would not be necessary at that site.

4.3.4 Biological Resources

4.3.4.1 Vegetation and Special Status Species

This alternative would result in identical effects to vegetation and special status plant species on public lands in the study area as under the Proposed Action, but those effects occurring at the Oxhide and GMC leach facilities would occur at different times. If, in the future, the GMC site could be expanded into the Webster alternative site locations, then the Oxhide site might not be needed and impacts to wetlands and the dace population at that location would be avoided.

4.3.4.1.1 Cumulative Effects

The cumulative effects under Alternative A are expected to be the same as for the Proposed Action.

4.3.4.1.2 Mitigation Measures and Monitoring

Mitigation and monitoring for Alternative A would be the same as for the Proposed Action.

4.3.4.2 Wildlife and Special Status Species

This alternative would result in identical effects to wildlife and special status wildlife species on public lands in the study area as under the Proposed Action, but those effects occurring at the Oxhide and GMC leach facilities would occur at different times. This alternative would disturb 0.571 acres of jurisdictional water habitat. Disturbance of 1.56 acres of wetland habitat at the Oxhide site would be delayed seven years.

4.3.4.2.1 Cumulative Effects

Cumulative effects to wildlife under Alternative A are expected to be the same as for the Proposed Action. Under this alternative, there would be no effect on the longfin dace in the pond at Oxhide site for seven years.

4.3.4.2.2 Mitigation Measures and Monitoring

Under this alternative, there would be no effect on the longfin dace in the pond at the Oxhide site for seven years. Mitigation and monitoring under Alternative A would be the same as for the Proposed Action.

4.3.5 Land Use

This alternative differs from the Proposed Action primarily in the effects on grazing. Effects on grazing would be similar under Alternative A, but the Lost Gulch allotment would be affected

earlier and the Bellevue allotment later than under the Proposed Action. If an alternative boundary is selected, the Bellevue allotment may not be affected. The Forest Service boundary fence would not be disturbed for seven years.

4.3.5.1 Cumulative Effects

Cumulative effects of Alternative A would be identical to those of the Proposed Action.

4.3.5.2 Mitigation Measures and Monitoring

Similar mitigation measures and monitoring would be considered for Alternative A as were considered for the Proposed Action.

4.3.6 Visual Resources

The delayed construction of the Oxhide leach facility would delay the visual intrusion for users of Castle Dome Road, but effects on visual resource management would be the same as for the Proposed Action.

4.3.6.1 Cumulative Effects

Cumulative effects of Alternative A on visual resources would be identical to those of the Proposed Action.

4.3.6.2 Mitigation Measures and Monitoring

Mitigation and monitoring under Alternative A would be the same as for the Proposed Action.

4.4 SUMMARY OF MITIGATION MEASURES AND MONITORING

This section presents a brief summary of the mitigation and monitoring measures proposed by the agencies to address adverse impacts not fully mitigated by the Operating Plan. Measures included in Cyprus Miami's Operating Plan are not discussed in this section, but are included in chapter 2.

4.4.1 Water Resources

Cyprus Miami would investigate closure technologies for copper oxide heap leach facilities throughout the life of the project. Cyprus Miami would submit a report concerning that research to the Forest Service and the BLM once every two years. Cyprus Miami would submit their recommended closure of the leach facilities to the Forest Service and the BLM two years prior to actual closure.

There is no mitigation for the loss or amendment of surface water rights. However, the water rights claimants would need to notify ADWR that the water sources would be lost or changed due to the mining operation. Water rights (and Accompanying Salt River adjudication claims) lost by the Proposed Action would be withdrawn; "changed" rights would go through the sever and transfer process or simply be amended to change the point of diversion, place of use or type of use.

4.4.2 Wildlife

Measures that would mitigate for the loss of the native longfin dace would be the capture and transplant of a large portion of the population from the existing impoundment to at least one of the proposed surface water impoundments. Additionally, transplanting longfin to more than one impoundment might even increase its population and distribution.

4.4.3 Cultural Resources

Twenty-seven cultural properties have been identified within the project areas for the proposed leach pads and five others are located close to these project areas. Site evaluation would be conducted using specified criteria. Evaluations and recommendations would then be reviewed and approved by the appropriate state and federal agencies. Sites found to be significant that are near the boundaries of the project areas could be protected by fencing or monitoring of any project activity in the vicinity of the sites. Data recovery plans would be developed for significant sites that cannot be avoided. Implementation of a site specific treatment plan is considered an adequate mitigation measure, but the treatment plan must be based on adequate evaluative investigations, and must be approved by the appropriate agencies under Section 106 of the National Historic Preservation Act.

4.4.4 Land Use

Forest Service-owned fences between allotments would need to be reconstructed around the facility and rebuilt in order to separate the allotments. Impacts to transportation would be mitigated by review by the Forest Service and BLM of all road closure requests by Cyprus Miami.

4.5 UNAVOIDABLE ADVERSE IMPACTS

The following discussion summarizes the adverse impacts from Alternative A (agency-preferred) that would occur after all mitigation measures were implemented. The discussion identifies impacts even if their effects would not be occurring off-site.

4.5.1 Geology and Minerals

The project would alter the topography of 1,057 acres and remove 2.8 billion pounds of copper from the ores present. After mining, the area would return to its previous land uses.

4.5.2 Water Resources

Adverse impacts to groundwater that would remain after implementation of all mitigation measures are discussed in detail in Section 4.2.3 and summarized in **Table 2-4**. Those impacts, which are all located **ON-SITE**, include:

- Depth to groundwater may increase adjacent to the BL Pit (p. 4-24)
- Possible exceedence of aquifer water quality standards (AWQS) for a short distance down-gradient of the leach facilities (p. 4-26).

Adverse impacts to surface water that would remain after implementation of all mitigation measures are discussed in detail in Section 4.2.4 and summarized in **Table 2-4.** Those impacts, which are all located ON-SITE include:

- Current drainage patterns would be altered (p. 4-30).
- 16 water sources would be covered by the proposed facilities (p. 4-30, 4-31, 4-33).
- Amendment or loss of water rights associated with water sources covered by the proposed facilities (p. 4-33).
- Loss of 9.22 acres of Waters of the U.S. (open water, drainages, and wetlands) (p. 4-35).

4.5.3 Soils and Reclamation

Short-term losses of soil productivity would occur on 1,057 acres of new disturbance. There would be long-term soil losses on 785 acres of steep slopes and other areas where revegetation is not proposed. These areas are expected to naturally revegetate and stabilize over time.

4.5.4 Biological Resources

Vegetation communities would be disturbed on 1,057 additional acres. Approximately 11.8 acres of impoundments and seven acres of riparian community would be lost, as would be 0.06 acres of wetlands.

Wildlife would be displaced from an additional 1,057 acres of habitat, although none of that habitat has been designated sensitive or critical. The disturbance would remove a red-tailed hawk nest and a Cooper's hawk nest. Forest Service and BLM-listed sensitive species would have habitat removed, but no individuals are expected to be affected with the exceptions of the longfin dace and lowland leopard frogs. A single water impoundment contains longfin dace, the only fish identified on the site, and the impoundment would be removed. Also, pond and riparian habitat used by lowland leopard frogs would be lost. Two impoundments would be

created larger in area than the resources lost, and wetland habitat is expected to develop around the impoundments.

4.5.5 Cultural Resources

The Proposed Action would affect 32 of the 43 cultural sites identified. Consultation with the State Historic Preservation Office is underway. It is expected that all sites would be fully mitigated.

4.5.6 Land Use

Approximately 1,057 acres would be converted from multiple-use lands to the mining land use. Certain areas of three grazing allotments and their included improvements would be removed, but the allowed number of AUMs would not be reduced. Little Pinto Canyon road (Forest road 608) would be closed to public access for the project life.

4.5.7 Visual Resources

Project facilities would contribute new visual intrusions to area landscapes, but the intrusions would be minor when viewed from key observation points and would be acceptable within the existing Visual Quality Objectives.

4.5.8 Hazardous Materials

Several thousand feet of piping would be constructed to transfer acidic leach solutions from leach facilities to the solvent extraction plant, thus increasing the potential for spills. However, piping would be placed in containment ditches where necessary, and when crossing drainages, piping would be placed to avoid sensitive receptors or would be contained by appropriate secondary containment features.

4.6 RELATIONSHIP BETWEEN SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Many of the impacts associated with the Cyprus Miami leach facility expansion project would be short-term and would not remain adverse after reclamation. The exception is socioeconomic effects, which would become adverse after closure. Proposed closure procedures have been developed to reclaim the proposed facilities in conjunction with the Arizona Department of Environmental Quality as part of the Aquifer Protection Permit Program. The principal short-term benefits of the proposed action include the continued production of copper for manufacturing of recyclable goods (2.8 billion pounds), and economic support for the

Globe-Miami community, Gila County, and the State of Arizona ($242 million annually in Arizona).

Groundwater would be consumed through dewatering in the short-term but the rate of consumption would not increase. Groundwater may be lost over the long-term from evaporation from residual impoundments following closure. Groundwater quality would be degraded downgradient of the leach facilities for distances ranging from the edge of the pad to 1,300 feet but no effects off-site. There would be no effect on surface water quality. There would be 1,057 acres of watershed removed from a total of 7,936 acres in the short-term, but over the long-term, the proposed facilities would again contribute to their local watersheds. Soil and vegetation productivity would be reduced in the short-term on 1,057 acres and in the long-term on 785 acres. Loss of individuals of sensitive plant species would be a short-term effect only. The longfin dace and lowland leopard frog populations would be reduced in the short-term, but the long-term effect on these species over their entire range would not be noticeable. The loss of site potential to support these species would be a long-term effect. Archaeological sites removed would represent a long-term loss. The socioeconomic benefits of continued employment and materials and equipment purchases would be a short-term effect, and multiple land use on public land would again be available after reclamation and closure.

These short-term and long-term effects would apply to implementation of the Proposed Action and Alternative A. The No Action alternative would require the short-term commitment of these resources for approximately ten years and would not provide economic benefits for as many years as the Proposed Action.

4.7 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

The development of the proposed action would result in the irreversible and irretrievable commitment of certain natural and fiscal resources. Major resource commitments include the land on which the facilities are located, as well as money, construction materials, labor, and energy. The potential impacts of using these resources is weighed against the benefits to be derived from the proposed action versus the consequences of taking no action.

Irreversible and irretrievable commitments of resources include 2.8 billion pounds of copper and other minerals that are removed from the mine. Cultural resources (archaeological sites) within areas proposed for disturbance would be irreversibly lost. Construction of the leach facilities, the waste rock disposal facility, and continued excavation of the open pits would irreversibly alter the landscape and visual qualities of the area. The loss of vegetation and wildlife habitat would be irretrievable, but not irreversible because reclamation at closure would restore vegetation and wildlife habitat in some areas. Groundwater would be consumed irretrievably through dewatering and subsequent consumption as well as loss of surface water resources and associated water rights. Some individual plants and wildlife would be irreversibly and irretrievably lost in disturbed areas due to construction activities but after closure would be

expected to repopulate the area. Soil development and productivity would be irreversibly and irretrievably lost in disturbed areas due to construction activities. The loss of 9.22 acres of jurisdictional waters of the U.S. represents an irreversible and irretrievable commitment of resources. These jurisdictional areas would be filled and graded; reclamation plans according to COE Habitat Mitigation and Monitoring Proposal would replace the existing systems but in different locations and degrees. The creation of approximately 60 acres of open water habitat would offset any loss of open water habitat in the area. Riparian areas would be lost as shown in **Table 4-19**, but all jurisdictional wetlands would be fully mitigated and some of the non-jurisdictional wetlands may be replaced by enhancement activities upstream of the new facilities or on Cyprus Miami-owned lands along Pinal Creek.

Table 4-19. Riparian Areas Lost

Type	Acres	Ownership
Fremont Cottonwood	4	FS, BLM
Goodding Willow	0.7	FS
Arizona Sycamore/Fremont Cottonwood	1	FS, BLM, Cyprus Miami
Tamarisk	1	FS, BLM
Wetlands	0.06	FS, BLM
Total	6.76	

The proposed action would also require a commitment of government services in the collection of taxes and regulatory oversight. A commitment of government resources would also be required to process the permit applications, monitoring of facilities (where appropriate), and for environmental analysis. The proposed action would maintain the revenues and employment potential of the Globe-Miami community, Gila County, and other communities and delay any unemployment in the copper industry.

5.0 CONSULTATION AND COORDINATION

5.1 DRAFT EIS PREPARATION

During preparation of the EIS, the BLM and Tonto National Forest solicited comments from many federal, state, and local agencies; public interest groups and civic organizations; and private individuals. Not all those solicited provided responses. Additionally, many individuals provided comments at the public scoping meeting. Following is a list of those who provided input during this phase of the NEPA process:

	Response*
Federal Agencies	
• U.S. Environmental Protection Agency, Farrel, D. J.	L
• U.S. Fish and Wildlife Service, Spiller, S.F.	L
• U.S. Geological Survey, Walker, B.M.	CF
• U.S. Bureau of Reclamation, Ellis, B.D.	L
State Agencies	
• Arizona Department of Agriculture, McGinnis, J. and K. Boyd	L
• Arizona Department of Mines and Mineral Resources, Coggin, M.H.	L
• Arizona Game & Fish Department, Heslin, B.	L
Regional and Local Agencies (including officers and administrators)	
• Globe Police Department, Baroldy, F. - Chief	CF
• Globe City Council	L
• Town of Miami	L
• Gila County Board of Supervisors, Salas, C.	L
• Gila County Community Development, Bigando, R.C.	L
• City of Globe, Franquero, D.A. - Mayor	L
Private Organizations	
• Arizona Toxics Information, Inc., Gregory, M.	L
• Sierra Club, Grand Canyon Chapter, Levick, L.	L
• Greater Globe-Miami Chamber of Commerce, Antilla, A.	L
• Southern Gila County Economic Development Corporation	L
• People for the West, Copper Trail Chapter, Ellio, T.D.	L
• People for the West, Globe-Miami Chapter, Hale, J. and McDonald, J.P.	L

Indian Tribes

- Yavapai-Prescott Tribe, Euler, R.C. — L

Individuals and Businesses

Aquirre, L./City of Globe	CF
Bennett, B.B.	L
Bingham, E.	CF
Bittner, R - Vice Mayor/City of Globe	L & CF
Blumer, E.	L
Boice, R.G.	L
Carpenter, E.C.	L
Carrillo, J., Mr. and Mrs.	CF
Clark, L. Mr. and Mrs.	L & CF
Clark, J.W.	CF
Coe, A.	L
Enders, L., Gerald Hills Ranch	L
Enders, W.A., E&N Mining and Construction, Inc.	L
Erickson, C., Erickson Land & Cattle Company	L
Gerber, T.F.	CF
Gibson, S.G., Gibson's Stores, Inc.	CF
Hamlet, G.J.	L
Handly, J.C.	CF
Hansen, L.B.	CF
Jacks, J.B.	L
Lenzi, G.	CF
Lorenz, R.	L & CF
Lundy, J.H.	L
McDonald, J.P., S.A.S./Industrial Maintenance Corporation	L
Pearce, K.	L
Pelger, R.J.	CF
Rasmussen, J.B., Magma Copper Company	L
Rice, C.E.	L
Sanderson, J.W., Friedlop Sanderson Raskin Paulson & Tourtillott	L
Scott, B.C.	L
Stoianoff, C.B.	L
Tamplin, M.L.	CF
Tarango, G.A. - City Clerk/City of Globe	CF
Thetford, D.R., Pacific Standard Specialties	L
Walker, B.	CF
Weir, J.H., Southern Gila County Economic Develop. Corp.	L
Williams, T.A.	CF
Wilson, J.R.	L

Media Notified

Arizona Silver Belt, Globe, AZ
Arizona Republic & Gazette, Phoenix, AZ
Copper Country News, Globe, AZ
Mesa Tribune, Mesa, AZ

*L = Letter
CF = Comment form during or after the Scoping Meetings

5.2 DRAFT EIS REVIEW

Approximately 165 copies of the Draft EIS have been mailed to interested parties on the BLM and Tonto National Forest mailing lists. In addition, the Draft EIS was made available for public review through the Internet (http://www.az.blm.gov/~cm/cm.htm) and at the following locations:

Tonto National Forest,
Supervisors Office
2324 East McDowell Road
Phoenix, AZ 85006

Globe Ranger Dist.
Six Shooter Canyon Road
Globe, AZ 85501

BLM Phoenix Field Office
2015 West Deer Valley Road
Phoenix, AZ 85027

BLM Arizona State Office
Public Room
222 North Central Avenue
Phoenix, AZ 85001-0555

Cyprus Miami Mining Corporation
Land Department
4342 East U.S. Highway 60/70
Claypool, AZ 85532

Miami Memorial Library
1052 Adonis
Miami, AZ 85539

Globe Public Library
330 South Broad
Globe, AZ 85501

Arizona State University
Hayden Library Reference Desk
Tempe, AZ 85287

Table 5-1. Agencies and Organizations Contacted During The Scoping Process

Federal Agencies and Elected Officials

Advisory Council on Historic Preservation
Office of Senator John Kyle
Office of Representative Hayworth
US Air Force—Luke Air Force Base
US Environmental Protection Agency
US Department of Agriculture
    Natural Resource Conservation Service
US Department of Energy
    Western Area Power Administration
US Department of Interior
    Fish & Wildlife Service
    Geological Survey
    Bureau of Mines
    Bureau of Reclamation
    Bureau of Indian Affairs
    National Park Service
    Office of Surface Mining
    Western Area Power Administration

Indian Tribes

Fort McDowell Mohave-Apache Indian Community
Hopi Tribe
Pueblo of Zuni
Salt River Pima, Maricopa Indian Community
San Carlos Apache Tribe
Tonto Apache Tribe
Yavapai-Apache Tribe
Yavapai Prescott Tribe
White Mountain Apache Council

Arizona State Agencies

Arizona State Mine Inspector
Arizona State Museum
Arizona State Parks Board
Arizona State University—Center for Public Affairs
Commission on the Arizona Environment
Department of Agriculture
Department of Environmental Quality
Department of Mines and Mineral Resources

Department of Game and Fish
Department of State Land
Department of Transportation
Department of Water Resources
Governor's Office
State Representative Hindman
State Representative Jackson
State Representative Mills
State Representative Palmer
State Senator Sossaman

Regional and Local Agencies

Apache Junction Planning Department
Central Arizona Water Conservancy
Globe City Council
Gila County Board of Supervisors
Gila County Planning and Zoning
Mayor, City of Apache Junction
Maricopa County Board of Supervisors
Pima County Governmental Center
Pima County Board of Supervisors
Pinal County Board of Supervisors
Salt River Project
Town of Miami
Town of Payson
Town of Superior

Private Organizations

Arizona Archaeological Society
Arizona Association of 4-W Drive Clubs
Arizona Cattle Growers Association
Arizona Mining Association
Arizona Nature Conservancy
Arizona Outdoor Coalition
Arizona Republic
Arizona Prospectors and Small Mine Operators Assn
Arizona Sonora Desert Museum
Arizona State Horseman's Association
Arizona Wildlife Federation
Arizona Wool Producers
American Mustang and Burro Assn.
Arizona Toxics Information, Inc.
Copper State 4-Wheelers

Greater Globe-Miami Chamber of Commerce
Independent Petroleum Association
Natural Resources Defense Council
Northern Arizona Audubon Society
People for the West, Copper Trail Chapter
People for the West, Globe-Miami Chapter
Pima Trails Association
Sierra Club, Grand Canyon Chapter
Southern Gila County Economic Development Corporation
Tucson Audubon Society
Tucson Rod and Gun Club
The Wildlife Society, ASU Chapter
The Wilderness Society

TABLE 5-2. Persons/Organizations/Agencies Receiving the DEIS

PERSONS/ORGANIZATIONS

D.K. Martin & Assoc.
Real Estate & Utilities
Federal Aviation Administration
Executive Director
Minerals Exploration Coalition
President, Globe-Miami Chapter
People for the West
Minerals Staff
USFS Nogales Ranger District
Wood Permits West, Inc.
Abel Alan J
Armour James M.
Arnold Ken
Bengson S. A.
Bittner E. Ross
Blaine Marjorie
Bodnar Bob
Boles Patrick H.
Brown George
Brunson-Hadley Dr. Judy
Burke Rebecca J.
Burkhardt Glynn G
Burton James E
Campbell Norma J
Cantou Pierre M.
Chew Matthew K.
Coker Betty L.
Cole Jane B.
Corathers Lisa
Corn Russell M.
Davis Marie
de Kok David A.
Dechambre David J.
Deen Linda
Dixon Robert M
Early George
Enders William A.
Erskine T.E. E.
Euler Robert C.
Eyde Dan T.
Feldman Bill
Felix Daniel M.
Fernley Landi
Fletcher Gary J.
Flood Tim
Gambell Neil A.
Garfield Mike
Garrison James W.
Gregory Michael
Hassell M. Jean
Hauge Erik R.
Heuslein Amy L.
Hobday Ross L
Hogan David
Horvath Bob
Jacks Jack B
John Edward C
Johnson David L.
Jones Douglas E
Keating Linus T
Kendall William T
Kirwan Edward A
LaFronz Nicholas J
Lancaster Donald E.
Laux Daniel P.
Leather Nancy L
Lorenz Ronald A
Lundy James H. Jr.
Malmquist Mike J
Marion Roger D
Martin Douglas K
Mawson Robert J
May Charles R
McCullen Sandee and John
Medhi P.K. Rana
Meyer David R
Nelson Doug C.
Nyenhuis James H.
Oppedahl Mark
Phillips Ken A.
Pinkava Donald J.
Porter Kenneth

Powers Richard L
Prendergast Ray A
Rabb David D
Radvak Steven J
Ramaley Karilee S.
Ramey Melodee A
Reid C.P. Patrick
Rice Clarence E.
Rickard Forrest R.
Rodke Col. R. B.
Rogge A. E.
Roscoe John G.
Saad Joni
Salas Cruz
Sater Greg X
Scacewater L.B.
Schmidt Fred C.
Scott Joan
Seidman Mike
Sell James D.
Shea James J.
Shipley Chuck
Shroyer Don
Siegel Michael S
Smith, Sr. Ted
Stanwood Mike
Stephenson John H
Steuter Don
Sullivan James H.
Thomas Rachel
Thompson Leslie E.
Valenzuela Jim C.
Vaughan Postelle R.
Walker David L
Welch John
Wendt Gene I.
Werner Frances W.
Whicker John E.
White Jack L.
Whitman Kathy G
Wiese Charles W.
Woods Lori Jones
Worden Marshall A.
Worman Terry
Young John M

GOVERNMENTAL OFFICES

Bureau of Reclamation
Denver, CO

Directorate of Environmental Quality
Civil Engineer HO USFS/CEVP

Director of Environmental Coordination
Dept. of Agriculture US Forest Service

Division of Environmental Compliance
DOI-National Park Service

Office of Federal Activities
Environmental Protection Agency

Chief, Division of Environmental Contaminants
Fish and Wildlife Service

Natural Resources Library
DOI

Head Acquisitions & Serial Branch
USDA - National Agricultural Library

Office of NEPA Oversight
Department of Energy

Director
DOI Bureau of Land Management

Office of Deputy A/S of the USAF

Environmental Review Coordinator
EPA Region IX

Chief, Environmental Policy & Program Div.
Minerals Management Service

Office of Public Affairs
DOI

Office of Environmental Project Coord.
DOI

Environmental Affairs Program
U.S. Geological Survey

US Geological Survey
Denver, CO

Director, Directorate of Planning
Southwestern Div-US Army Corps of Engineers

Engineering Review and Permit Unit
Arizona Dept of Environmental Quality

ELECTED OFFICIALS IN CYPRUS MIAMI JURISDICTION

Federal
Congressional Dist. 6 - Rep. J.D. Hayworth
Senator John McCain
Senator John Kyl

State
Gov. Fife Symington
Rep. Debra Brimhall
Rep. Franklin L. (Jake) Flake
Senator Jack Brown

Local (County/City)
Mayors:
City of Globe
City of Miami
City of Superior

County Board of Supervisors - Gila County

6.0 LIST OF PREPARERS AND REVIEWERS

Agency EIS Interdisciplinary Team

Responsibility	Name	Qualifications
ID Team Co-Leaders		
	Paul M. Stewart Tonto National Forest Supervisors Office	B.S. in Watershed Management 18 years experience
	Mary Johnson Bureau of Land Management Arizona State Office	B.A. in Management (March '97) 16 years experience
Tonto National Forest ID Team Members		
Water Resources	Lynn Mason Tonto National Forest Supervisor's Office	B.S. in Geology 6 years experience
Geology, Minerals, and Hazardous Materials	Karyn Bronson Harbour Tonto National Forest Supervisor's Office	B.S. in Geology 11 years experience
Recreation, Wilderness, Minerals, and Land Use	Stuart J. Herkenhoff Tonto National Forest Globe Ranger District	B.S. in Wildlife Management B.S. in Range Management 22 years experience
Biological Resources, T&E and Riparian	Craig Woods Tonto National Forest Zone Biologist	B.S. in Field Biology M.S. in Ecology 22 years experience
Visual Resources	Ron Wilson Tonto National Forest Supervisor's Office	B.S. in Landscape Architecture 23 years experience
Air Resources and Noise	Peter Lahm Tonto National Forest Supervisor's Office	Master of Environmental Mgmt. B.A. in Chemistry 6 years experience
Cultural Resources	Scott Wood Tonto National Forest Supervisor's Office	B.A. in Anthropology M.A. in Archaeology 22 years experience

Soil and Reclamation	Norm Ambos Tonto National Forest Supervisor's Office	B.S. in Soils B.A. in Chemistry 17 years experience
BLM ID Team Members		
Mining Engineer	Moon Hom Arizona State Office	B.S. Mining Engineering 18 years experience
Soils/Air/Noise	Jim Renthal Arizona State Office State Air Leader	M.S. in Watershed Management B.A. in Psychology 26 years experience
Hydrology	Steve Markman Phoenix Resource Area	M.S. in Watershed Management 10 years experience
	Lin Fehlman Phoenix District Office Water Rights	B.S. in Secondary Education and Biology 16 years experience
Vegetation, Wildlife, T&E Species, Riparian	Tim Hughes Phoenix Resource Area	B.S. in Wildlife Biology 10 years experience
Socioeconomics	Christina (Gina) Ramos Arizona State Office	B.S. in Range Science M.B.A. 15 years experience
Cultural Resources, Visuals	Connie Stone Phoenix Resource Area	Ph.D. in Anthropology 22 years experience
Geology	Ron Smith Phoenix Resource Area	B.S. in Mechanical Engineering B.S. in Geology 14 years DOI experience
Hazardous Materials	Bruce Talbott Arizona State Office	B.S. in Engineering B.S. in Natural Resources 20 years experience
Public Affairs	Deborah E. Stevens Arizona State Office	B.A. in Journalism Mass Communications 15 years experience

Corps of Engineers—Cooperating Agency Review		
Clean Water Act Section 404 Permitting	Marjorie Blaine Phoenix Office	M.S. in Biology B.S. in Biology and Chemistry 16 years experience
Third Party Contractor Greystone		
Principal-in-Charge	Randy Schroeder	M.S. Environmental Science 19 years experience
Project Manager	Dehn Solomon	M.S. Biology 25 years experience
Air Quality/Noise	D. Douglas	M.S. Meteorology 26 years experience
Soils	W. Mahoney, P.G.	M.A. Geography 14 years experience
Visual Resources	L. Keith	B.L.A. 20 years experience
Surface Water/Hydrology/ Water Quality	B. Walker, RCE	M.S. Civil Engineering 35 years experience
	C. Begej	B.S. Environmental Geology 15 years experience
Vegetation/Wetlands Grazing	D. Tiglas	M.S. Range 8 years experience
Land Use/Recreation/ Transportation	J. Forsythe	MCRP 7 years experience
	L. Welch	B.S. Earth Sciences 4 years experience
Wildlife/Fisheries/ T&E Species	D. Cameron	M.S. Animal Ecology 17 years experience
	M. Bonar	B.S. Environmental Ecology 6 years experience
Hazardous Materials	M. Sydnor	B.S. Geology 6 years experience

Poudre Environmental Consultants		
Assistant Project Manager	Russ Moore	PhD. Ecology 21 years experience
	J. Nyenhuis	Cert. Soil Professional 17 years experience
AGRA Earth and Environmental		
Groundwater Hydrology	R. Bansberg, P.G.	B.A. Earth Sciences 15 years experience
Engineering Review	G. Beckwith, P.E.	B.S. Civil Engineering 30 years experience
	N. LaFronz, P.E.	M.S. Engineering (Soil Mech.) 14 years experience
	D. Sergent, P.E.	M.S. Civil Engineering 32 years experience
	T. Walker, P.G.	B.S. Geology 8 years experience
Geology	E. Weiland, P.G.	M.S. Geochemistry 18 years experience
Metcalf Archaeological Consultants		
Cultural Resources	M. Metcalf	M.A. Anthropology 21 years experience
Gochnour & Associates		
Reclamation Review	P. Gochnour	B.S. Park Admin. Land Use Planning 13 years experience

Western Economic Analysis Center		
Socioeconomics	G. Leaming	Ph.D. Economics 29 years experience
Cyprus Miami Mining Corporation		
Project Supervisor,	J. Spehar	Senior Landman
Technical Information,	R. Ressler	Environmental Manager
Document Review, and	J. Clark	Geologist
Mine Planning	C. Iles	
	G. Davis	Mining Engineer
	E. Bilson	Mining Engineer
		Metallurgist
Environmental	K. Whitman Whitman & Company	B.S. Range Science 14 years experience
Design Project Director	B. Bronson P.E. Golder Associates, Inc.	M.S. in Geotechnical Engineering 12 years experience

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Herkenhoff, S. 1995b. Personal Communication. Recreation Specialist, Globe Ranger District, Tonto National Forest, with J. Forsythe, Greystone, Sacramento, California.

Heslin, B. 1995. Personal Communication. Habitat Specialist. Arizona Game and Fish Department, Mesa, Arizona, with M. Bonar, Greystone, Englewood, Colorado.

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8.0 ACRONYMS AND ABBREVIATIONS AND GLOSSARY

ACRONYMS AND ABBREVIATIONS

ADA	Arizona Department of Agriculture
ADEQ	Arizona Department of Environmental Quality
ADOT	Arizona Department of Transportation
ADT	Average Daily Traffic
ADWR	Arizona Department of Water Resources
AGFD	Arizona Game & Fish Department
ANSI	American National Standards Institute
APP	Aquifer Protection Permit
AQG	Ambient Air Quality Guidelines
AQRV	Air Quality Related Values
ARPA	Archaeological Resource Preservation Act
ASMIO	Arizona State Mine Inspectors Office
AUM	Animal Unit Month
BADCT	Best Available Demonstrated Control Technology
bext	Extinction coefficient
BGS	Below Ground Surface
BLM	U.S. Bureau of Land Management
BMPs	Best Management Practices
CAAG	Central Arizona Association of Governments
CAP	Corrective Action Plan
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	Cubic Feet per Second
COE	U.S. Army Corps of Engineers
CPT	Corrugated Polyethylene Tubing
CWA	Clean Water Act
dv	Deciview
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
EPGA	Effective Peak Ground Acceleration
ESA	Endangered Species Act
ft-above msl	Feet Above Mean Sea Level
GIS	Geographic Information System
gpm	Gallons per Minute
gm/l	Grams per Liter
gr/l	Grams per liter
HAPS	Hazardous Air Pollutants
H:V	Horizontal to vertical

HCDA	Historic Context Development Area
HDPE	High-density polyethylene
km	Kilometer
KOP	Key Observation Point
LCRS	Leachate collection and recovery system
LLDPE	Linear low-density polyethylene
LOS	Level of service
m/s	Meters per second
MCL	Maximum Contaminant Level
METF	Mineral Extraction Task Force
mm	Millimeters
MSDS	Material Safety Data Sheet
MSHA	Mine Safety and Health Administration
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NWS	National Weather Service
OSHA	Occupational Safety and Health Administration
PILT	Payment in Lieu of Taxes
PLS	Pregnant leach solution
PM_{10}	Respirable particulate matter less than ten microns in aerodynamic diameter
POC	Point of Compliance
ppb	Parts per billion
ppm	Parts per million
PSD	Prevention of significant deterioration
psi	Pounds per square inch
RACM	Reasonably Available Control Methods
RACT	Reasonable Available Control Technologies
RNA	Roaded Natural
ROS	Recreation opportunity spectrum
RUSLE	Revised Universal Soil Loss Equation
RVD	Recreational visitor day
SCHMM	Spill Containment and Hazardous Materials Management
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
SPM	Semi-primitive motorized
SPNM	Semi-primitive non-motorized
SVR	Standard visual range
SWPP	Stormwater Pollution Prevention Plan
SX/EW	Solvent extraction/electro-winning
TDS	Total Dissolved Solids

TSP	Total suspended particulate
TSS	Total suspended solids
U	Urban
USFWS	U.S. Fish & Wildlife Service
USGS	U.S. Geological Survey
USLE	Universal Soil Loss Equation
UTM	Universal Transverse Mercator
VLDPE	Very-low-density polyethylene
VOC	Volatile organic compound
VQO	Visual Quality Objective
WQARF	Water Quality Assurance Revolving Fund

GLOSSARY

Acid-consuming — A natural characteristic of some rocks and/or soils where the materials have the ability to neutralize (or consume) acid.

Acid Rock Drainage — Drainage with a pH of 2.0 to 4.5 from mines and mine wastes that is the result of oxidation of sulfides exposed during mining.

Acid-generating — A natural characteristic of some rocks and/or soils where the materials produce acid naturally.

Acre-feet — The volume of liquid or solid required to cover one acre to a depth of one foot, or 43,560 cubic feet; measure for volumes of water, reservoir rock, etc.

Adit — A nearly horizontal passage in an underground mine, driven from the surface, by which a mine may be entered, ventilated, and/or dewatered.

Air Quality Related Values — Values in federally-designated Class I areas which can be negatively impacted by degraded air quality, including Flora and Fauna, Soils, Water Quality, Cultural Resources, and Visibility.

Alkalinity — A measurement of the relative concentration of strong bases (e.g. sodium or potassium) in a substance in relation to strong acids.

Allotment — A unit of land suitable and available for livestock grazing that is managed as one grazing unit.

Alluvium — Unconsolidated materials deposited by streams.

Ambient — The environment as it exists at the point of measurement and against which changes or impacts are measured.

Animal Unit Months (AUMs) — For the BLM allotments, it is the amount of forage consumed by a 1,000 pound cow over a one month period, approximately 800 pounds of forage. An animal unit month is then multiplied by 1.32 for a cow/calf operation and is equivalent to an animal month for purposes of this document.

Anomaly — A geological feature, especially in the subsurface, distinguished by geological, geophysical, or geochemical means, which is different from the general surroundings.

Aquifer — A body of rock that is sufficiently permeable to conduct groundwater and to yield economically significant quantities of water to wells and springs.

Confined aquifer — An aquifer at depth, bound above and below by impermeable materials (clays, rocks, formations, etc.).

Unconfined aquifer — an aquifer, the upper surface of which is the ground water table (air-water contact surface).

Aspect — The direction toward which a slope faces with respect to the compass or the sun.

Background — The viewing area of a distance zone that lies beyond the foreground-middleground. Usually from a minimum of 3 to 5 miles to a maximum of about 15 miles from a travel route, use area, or other observer position. Atmospheric conditions in some areas may limit the maximum to about 8 miles or increase it beyond 15 miles.

Basalt — An extrusive rock composed primarily of calcic plagioclase and pyroxene, with or without olivine.

Baseline Study — A study conducted to gather data prior to mining for the purpose of outlining conditions existing on an undisturbed site. Impacts are evaluated against the baseline data and reclamation success is measured against baseline data.

Best Management Practices (BMP) — a practice or combination of practices determined by the state to be the most effective and practicable (including technological, economic and institutional considerations) means of preventing or reducing the amount of pollution generated by non-point sources to a level compatible with water quality goals.

Biodiversity — The diversity of species, ecosystems, and natural processes in an area.

Biotic — Pertaining to life and living organisms.

Biotite Schist — A medium grained rock produced by recrystallization by intense heat and/or pressure. Its principal component is biotite, a member of the mica family of minerals. The mica crystals are oriented in a subparallel form.

Broadcast seeding — Distribution of seed by a fan spreader or by hand spreading.

Browse — Shrubby forage utilized especially by big game.

Cambrian — The earliest period of the Paleozoic Era of geologic time lasting from approximately 570 to 505 million years before the present.

CFR — Code of Federal Regulations, the compilation of federal regulations adopted by federal agencies through a rule-making process.

Characteristic Landscape — The established landscape within an area being viewed. The term does not necessarily mean a naturalistic character, but may refer to features of the cultural landscape, such as a farming community, an urban landscape, or other landscape that has an identifiable character.

Class II Airshed — a geographical region which can accommodate normal well-managed industrial growth before significant air quality deterioration would be deemed to occur.

Climax — The highest ecological development of a plant community capable of perpetuation under the prevailing climatic and edaphic conditions.

Colluvium — A mixture of soil and angular fragments of rock which have accumulated at the foot and on slopes of mountainsides under the influence of gravity.

Community Right to Know — Title III of the Comprehensive Environmental Response, Compensation and Liability Act, as amended.

Community Types (vegetation) — A group of plants living in a specific region under relatively similar conditions.

Conglomerate — A sedimentary rock comprised of an unstratified mixture or stratified layers of cobbles, gravel, and sand.

Contrast rating — A method of determining the extent of visual impact for an existing or proposed activity that would modify any landscape feature.

Creep — A imperceptibly slow, relatively continuous downslope movement of rock and soil.

Cretaceous — The period of geologic time lasting from 144 to 66 million years before present which is also known as the "age of dinosaurs"

Cultural Resources — The archaeological and historical remains of human occupation or use. Includes any manufactured objects, such as tools or buildings. May also include objects, sites, or geological/geographical locations significant to Native Americans.

Cumulative Effect — the effect on the environment which results from the incremental effects of the action when added to other past, present, and reasonable foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7).

Dacite — An igneous rock type, usually volcanic in origin.

Debitage — Chipped stone flaking debris resulting from stone tool making.

Decibels (dBA) — Units for describing amplitude of sound frequencies to which the human ear is sensitive.

Deciduous — Trees or shrubs which loose their leaves each year during a cold or dry season.

Demographic — Pertaining to the study of human population characteristics including size, growth rates, density, distribution, migration, birth rates, and mortality rates.

Desired Future Condition — the physical changes which are anticipated to result from carrying out planned management practices at two points in time; at the end of ten years and the end of fifty years.

Diabase — A rock of basaltic composition consisting essentially of labradorite and pyroxene, and characterized by ophitic texture.

Dikes — A tabular body of igneous rock that cuts across the structure of adjacent rocks or cuts massive rocks; most result from the intrusion of magma.

Direct Effects — As defined by 40 CFR 1508.9, these are effects which are caused by the action and occur at the same time and place as the action. Synonymous with direct impacts.

Direct Impact Area — An area analyzed for the effects of an action that would occur at the same place in time.

Discharge — The volume of water flowing past a point per unit time, commonly expressed as cubic feet per second (cfs), gallons per minute (gpm), or million gallons per day (mgd).

Dispersed Recreation — a general term referring to recreation use outside the developed recreation site; this includes activities such as scenic driving, hunting, backpacking, and recreation in primitive environments.

Disseminated — Fine particles of minerals, scattered through rock or gangue matter, and without genetic significance.

Distance Zones — areas of landscapes denoted by specified distances from the observer. Used as a frame of reference in which to discuss landscape characteristics or activities of man.

Background (bg) — area located from 3–5 miles to infinity from viewer.

Middleground (mg) — area located from 0.25–0.50 to 3–5 miles from the viewer.

Foreground (fg) — the detailed landscape found within 0 to 0.25–0.50 mile from the viewer.

Dolomite — A common mineral consisting of calcium magnesium carbonate.

Drawdown — The lowering of the water level in a well as a result of withdrawal.

Ecosystem — an interacting system of organisms considered together with their environment for example, marsh, watershed, and stream ecosystems.

Ecotone — The boundary or transition zone between adjacent plant communities, often delineating different habitat types.

Edaphic — Pertaining to the soil.

Effects — Environmental consequences as a result of a proposed or alternative action. Included are direct effects, which are caused by the action and occur at the same time and place, and indirect effects, which are caused by the action and are later in time or further removed in distance but which are still reasonably foreseeable. Also referred to as impacts.

Electrowon copper — Copper that is recovered through the solvent extraction, electrowinning technology.

Endemic — Confined naturally to a particular geographic area. Often used in opposition to the word epidemic.

Environmental Impact Statement (EIS) — a detailed statement prepared by the responsible official in which a major Federal action which significantly affects the quality of the human environment is described, alternatives to the proposed action provided, and effects analyzed.

Ephemeral Drainage — A stream which flows only during and immediately after rainfall or snowfall events.

Erosion — The wearing away of soil and rock by weathering, mass wasting, and the action of streams, glaciers, waves, wind, and underground water.

Evapotranspiration — The portion of precipitation returned to the air through evaporation and plant transpiration.

Exotic Plant — Not native to a given area; an introduced plant.

Fault — A fracture in bedrock along which there has been vertical and/or horizontal movement caused by differential forces in the earth's crust.

Fissure — In geologic materials, any narrow opening, cleft, crevice, or furrow.

Floodplain — That portion of a river valley, adjacent to the channel, which is built of sediments deposited during the present regimen of the stream and is covered with water when the river overflows its banks at flood stages.

Folding — Bending of bedrock generally in response to deformation of the earth's crust.

Foliation — The laminated structure in rocks resulting from segregation of different minerals into layers parallel to cleavage planes.

Forage — Vegetation used for food by wildlife, particularly big game wildlife and domestic livestock.

Forb — Any herbaceous plant other than a grass.

Foreground-Middleground — The area visible from a travel route, use area, or other observer position to a distance of 3 to 5 miles. The outer boundary of this zone is defined as the point where the texture and form of individual plants are no longer apparent in the landscape, and vegetation is apparent only in pattern or outline.

Fracture — Linear breaks or ruptures within rock masses.

Fugitive Dust — Dust particles suspended randomly in the air from road travel, excavation, and rock loading operations.

Fugitive Emissions — Emissions generated from open sources and not discharged in any confined flow stream.

Geochemistry — The study of the distribution and amounts of the chemical elements in minerals, ores, rocks, soils, water, and the atmosphere, and their circulation in nature, on the basis of the properties of their atoms and ions.

Geology — The science of the earth, including the composition, structure, and origin of its rocks.

Geotechnical — A branch of engineering concerned with the engineering design aspects of slope stability, settlement, earth pressures, bearing capacity, seepage control, and erosion.

Granitic Bedrock — A coarse grained rock consisting chiefly of quartz and feldspar which has been formed by the slow cooling of molten magma within the earth's crust.

Granodiorite — A rock type consisting of quartz, calcic oligoclase and orthoclase. It is intermediate between quartz monzonite and quartz diorite.

Ground Cover — The amount of ground surface covered by vegetation.

Ground Water — All subsurface water, especially that as distinct from surface water portion in the zone of saturation.

Growth Medium — A term for the combination of soils, subsoils and rock fragments, or native surface materials in the absence of true soils.

Habitat Fragmentation — The process by which habitats are increasingly subdivided into smaller units, resulting in their increased isolation as well as loss of total habitat area.

Habitat Type — The aggregate of all areas that support or can support the same primary vegetation at climax.

Heavy Metals — A group of elements that may be acquired by organisms in trace amounts that are toxic in higher concentrations. Includes copper (Cu), lead (Pb), mercury (Hg), molybdenum (Mo), nickel (Ni), cobalt (Co), chromium (Cr), iron (Fe), silver (Ag), etc.

Herbaceous — The plant strata which contain soft, not woody, stemmed plants that die to the ground in winter.

Holocene — The epoch of geologic time since the end of the last "Ice Age," approximately 10,000 years before the present.

Host Rock — A body of rock serving as a host for mineral deposits.

Hydraulic conductivity — A quantitative measure of the ability of material such as rock to transmit water. Units are distance over time, such as centimeters per second.

Hydrology — A science that deals with the properties, distribution, and circulation of surface and subsurface water.

Hydrostratigraphic unit — Geologically, a subsurface strata (layer) that contains water.

Igneous — Rock formed from solidification of molten magma within the earth or extruded on to the surface during a volcanic eruption

Impoundment — The accumulation of any form of water in a reservoir or other storage area.

Indirect Effects — As defined by 40 CFR 1508.8, these are effects which are caused by the action but occur later in time or are removed in distance from the action, but are still reasonably foreseeable. Synonymous with indirect impacts.

Indurated — Rock or soil which has been hardened by heat, pressure, or cementation.

Infiltration — The movement of water or some other liquid into the soil or rock through pores or other openings.

Infrastructure — The basic framework or underlying foundation of a community including road networks, electric and gas distribution, water and sanitation services, and facilities.

Intermittent Stream — A stream with alternating surface and subsurface flow, usually flowing seasonally.

Interstitial — Situated in a small or narrow space between cellular components; crevice; crack.

Intruded — A body of rock that has been invaded by a body of igneous rock. The invading rock may be a plastic solid, or magma that pushes its way into the older rock.

Irretrievable — Applies to the loss of production, harvest, or use of natural resources. For example, some or all of the timber production from an area is lost irretrievably while an area is serving as a winter sports site. The production lost is irretrievable, but the action is not irreversible. If the use changes, it is possible to resume timber production.

Irreversible — Applies primarily to the use of nonrenewable resources, such as minerals or cultural resources, or to those factors that are renewable only over long time spans, such as soil productivity and aspen regeneration. Irreversible also includes loss of future options.

Joints — Geologically, a series of approximately parallel divisional planes (discontinuities, cracks, or breaks) occurring in many rocks.

Jurisdictional waters — Waters (including rivers, lakes, creeks, etc.) which are under the jurisdiction of the Federal Government under Section 404 of the Clean Water Act (see waters of the United States).

Jurisdictional wetland — A wetland area identified and delineated by specific technical criteria, field indicators, and other information for purposes of public agency jurisdiction.

Key Observation Point (KOP) — One or a series of points on a travel route or at a use area or a potential use area, where the best view of a management activity is available.

Landscape Character — The arrangement of a particular landscape as formed by the variety and intensity of the landscape features as defined as the four basic elements (form, line, color, and texture). These factors give the area a distinctive quality that distinguishes it from its immediate surroundings.

Land Use — Land uses determined for a given area that establish the types of activities allowed (e.g., mining, agriculture, timber production, residences, industry) and the size of buildings and structures permitted.

Level of Service (LOS) — A qualitative measure of traffic operating conditions whereby a letter grade corresponding to progressively worsening traffic conditions is assigned to an intersection, freeway ramp junction, or roadway segment.

Lifts — Construction of waste rock dumps in a series of layers.

Liquefaction — Loss of apparent shear strength and downslope movement of water-saturated sands and silts in the manner of fluid or semi-fluid flow.

Long-Term Effects — Long-term effects are effects that would remain following completion of the project. As an example, the loss of vegetation from the development of an open pit would be a long-term effect if the pit were not reclaimed and vegetation not re-established at the end of the project. Other long-term effects, as defined in the Cumulative Effects Analysis (CEA), are coarse and durable angle of repose waste rock dump slopes and haul roads.

Management Indicator Species (MIS) — Species that indicate habitat suitability for other species of similar habitat needs and are used to monitor and guide wildlife diversity. A decline in MIS population signals a decline for other species living in the area.

Mass Wasting — Movement of large masses of earth material, either slowly or rapidly, under the force of gravity

Maximum Modification — A visual quality objective that allows activities that alter the vegetation and landform to dominate the original characteristic landscape with some limitations.

Mesic — Moist habitats associated with springs, seeps and riparian areas.

Mesozoic — The era of geologic time from 245 to 66 million years ago and corresponding to the proliferation of reptiles and the beginnings of mammalian life

Metamorphic Bedrock — A class of rock which has recrystallized within the earth's crust in response to intense pressure and/or heat.

Mineralization — Process of introducing minerals into bedrock.

MIS — management indicator species.

Mitigate, Mitigation — To cause to become less severe or harmful to reduce impacts. Actions to avoid, minimize, rectify, reduce or eliminate, and compensate for impacts to environmental resources.

Modification — A visual quality objective in which man's activity may dominate the characteristic landscape, but should appear as a natural occurrence when viewed as background.

Modified Mercalli Intensity Scale — A qualitative measurement scale describing the intensity (degree of shaking) felt by people, structures, and the ground. Intensities range from I (felt by few, if any, people) to XII (damage total).

Multiple Use — Management of the public lands (both BLM and Forest Service) and their various resource values so they are utilized in the combination that will best meet the present and future needs of the public.

NAAQS — National Ambient Air Quality Standards

National Register of Historic Places — A list, maintained by the National Park Service, of areas which have been designated as being of historical significance.

Natural Succession — Plant community change over time.

NEPA — The National Environmental Policy Act of 1969. It is the national charter for protection of the environment. NEPA establishes policy, sets goals, and provides means for carrying out the policy. Regulations at 40 CFR 1500-1508 implement the act.

Neutral — Neither acidic (low pH) nor basic (alkaline with high pH).

Nominal — Within a narrow range close to the desired result.

Noxious Weeds — An alien, introduced, or exotic undesirable species that is aggressive and overly-competitive with more desirable native species.

One-hundred year, twenty-four-hour storm event (100-year, 24-hour) — the maximum precipitation predicted to occur within any 24-hour period over a period of 100 years.

Ordovician — The second period of the Paleozoic Era of geologic time lasting from approximately 505 million to 438 million years before the present.

Ore — A deposit of rock from which a valuable mineral or minerals can be economically extracted.

Orthoquartzite — A sedimentary rock comprised of quartz sand which has been cemented by silica.

Overburden — Material which overlies a deposit of valuable material.

Overstory — That portion of the trees, in a Forest of more than one story, forming the upper or uppermost canopy.

Oxide ore — Ore containing a binary compound of an element with oxygen; easily leachable by a sulfuric acid solution.

Packer Tests — A test to determine the hydraulic conductivity of an aquifer by observing the rate water flows through the aquifer under different pressures. The pressures are created by isolating the aquifer with "packers" (inflatable balloons placed above and below) in the bore hole, and then injecting water at different rates into the hole between the packers by means of a pump.

Paleocene — The earliest epoch of the Tertiary Period lasting from 65 to 58 million years before the present

Paleontology — The science which deals with the history and evolution of life on earth.

Paleozoic — The era of geologic time from 570 to 245 million years ago and corresponding to the proliferation of complex marine life forms and the beginnings of terrestrial plant and animal life

Partial Retention — A visual quality objective in man's activities may be evident, but must remain subordinate to the characteristic landscape.

Patent — A document conveying title to land from the U. S. Government to private ownership.

Peak Flow — the highest value of stream stage or flow attained during a flood.

Perched Water — Unconfined groundwater separated from the underlying main body of groundwater by unsaturated rock.

Perennial Stream — A stream or spring with year-round surface flow.

Permeability — A qualitative description of the ability of material such as rock to transmit fluid. Similar to but not the same as hydraulic conductivity.

pH — The negative $\log_{10}$ of the hydrogen ion activity in solution; a measure of acidity or basicity of a solution.

Pit Backfill — Placing waste rock in a mined-out pit.

Plagioclase — A group of common rock forming minerals comprised of aluminum silicon oxides with varying ratios of sodium and calcium.

Plan of Operations — As required by 36 CFR 228.4, the operator submits a Plan of Operations (POO) to the USFS that includes: the name and address of the operator, location of the proposed area of operations, information sufficient to describe the type of operations proposed, and measures to be taken to meet the requirements for environmental protection.

Pleistocene — The epoch of geologic time lasting from 2 million to 10,000 years before the present which is also known as the "Ice Age"

Pliocene — The epoch of the Tertiary Period lasting from 5 to 2 million years before the present.

PM_{10} — airborne suspended particles with an aerodynamic diameter of 10 microns or less

Point Source Emissions — Atmospheric emissions which are discharged through a pipe, vent or opening.

Preservation — A visual quality objective that provides for ecological change only.

Priority Pollutant — One of 126 chemical substances (including metals, volatile organic compounds, and semi-volatile organic compounds) listed by the U.S. Environmental Protection Agency as water pollutants. These substances may be subject to regulation under the Federal Clean Water Act.

Probable Maximum Flood Event — Derived from the Probable Maximum Precipitation, described below.

Probable Maximum Precipitation — Estimated from the most severe combination of meteorological and orographic conditions believed to be possible under existing climatic conditions; roughly three to five times the 100-year rainfall for inland basin, mountain, and desert regions in the western U.S.

Productivity — In reference to vegetation, productivity is the measure of live and dead accumulated plant materials.

Protohistoric — Time period when native culture is in contact with outside culture before written record.

Quaternary — Period of the earth's history from two million years ago to the present.

Quartzite — A granular metamorphic rock comprised mostly of quartz.

Radionuclides — Radioactive atoms given off by radioactive materials as decay products.

Range — Land producing native forage for animal consumption and lands that are revegetated naturally or artificially to provide forage cover that is managed like native vegetation, which are amenable to certain range management principles or practices.

Raptor — A bird of prey (e.g., eagles, hawks, falcons, vultures and owls).

Reclamation — The employment during and after a mining operation of measures designed to mitigate the disturbance of affected areas to the extent practical.

Recontouring — Restoration of the natural topographic contours by reclamation measures, particularly in reference to roads.

Record of Decision (ROD) — A decision document for an Environmental Impact Statement or Supplemental EIS that publicly and officially discloses the responsible official's decision regarding the actions proposed in the Environmental Impact Statement and their implementation.

Recreation Opportunity Spectrum (ROS) Settings — a system of measuring the land's ability to meet the expectations of recreation users. Six recreation categories, from primitive (natural) to urban (highly modified) describe the activities, settings and experiences an area offers. The following categories may be found in or near the analysis area:

Roaded Natural (RN) — a road corridor with a landscape that is characterized as natural or natural appearing. The road has moderate to high use.

Roaded Modified (RM) — a moderate to large landscape area that has been modified by man. In a forest setting, the modifications are roads and obvious management activities, such as timber harvest and mining.

Recreation Visitor Day (RVD) — equivalent to 1 person recreating for 12 hours or several people for a total of 12 hours.

Reserves — Identified resources of mineral-bearing rock from which the mineral can be extracted profitably with existing technology and under present economic conditions.

Retention — A visual quality objective which generally means man's activities should not be evident to the casual forest visitor.

Riparian Area or Habitat — Situated on or pertaining to the bank of a river, stream, or other body of water. Riparian is normally used to refer to plants of all types that grow along streams, rivers, or at spring and seep sites

Runoff — That part of precipitation that appears in surface streams; Precipitation that is not retained on the site where it falls and is not absorbed by the soil.

Safety Factors — Ratio of the forces that resist failure to the forces that cause failure.

Scatter (archeological) — The most common type of archaelological site, consisting of artifacts distributed over the surface of the ground.

Schist — A banded metamorphic rock which shows a parallel orientation of mica or the other dominate minerals which comprise it.

Scoping — Procedures by which agencies determine the extent of analysis necessary for a proposed action, (i.e., the range of actions, alternatives, and impacts to be addressed; identification of significant issues related to a proposed action; and the depth of environmental analysis, data, and task assignments needed). (40CFR 1501.7)

Sediment — Solid materials, mineral or organic that have been transported in suspension to stream channels or other bodies of water/and have come to rest (deposition).

Sedimentary — Rock formed from fragments of pre-existing rocks (e.g. sandstone) or by precipitation from solution (e.g. limestone)

Seismicity — The likelihood of an area being subject to earthquakes; the phenomenon of earth movements.

Sensitive Species — those plant or animal species which are susceptible or vulnerable to activity impacts or habitat alterations.

Sensitivity Level — a particular degree or measure of viewer interest in the scenic qualities of the landscape.

Sensitivity Level 1 — the highest sensitivity level, referring to areas seen from travel routes and use areas with moderate to high use.

Sensitivity Level 2 — an average sensitivity level, referring to areas seen from travel routes and use areas with low to moderate use.

Sensitivity Level 3 — the lowest sensitivity level, referring to areas seen from travel routes and low use areas.

Shear Zone — A volume of bedrock that has been fractured and often mineralized by stresses and faulting within the earth's crust.

Short-Term Effects — Short term effects are defined under the Cumulative Effects Analysis (CEA) process as those effects that would not last longer than the life of the project.

Significant — As used in NEPA determination of significance requires consideration of both context and intensity. Context means that the significance of an action must be analyzed in several contexts such as society as a whole, and the affected region, interests, and locality. Intensity refers to the severity of impacts (40 CFR 1508.27).

Siliceous — Containing silica (quartz), the mineral composed of silicon dioxide.

Sill — An intrusive body of igneous rock of uniform thickness, relatively thin, which has been emplaced parallel to the bedding of the intruded rocks.

Slug tests — A test to determine the hydraulic conductivity of an aquifer by observing the rate a column of water (hydraulic head) in a bore hole drops (dissipates) as water seeps out into the aquifer. In this context, the water level was raised to perform the test by displacing a volume of water in the hole with a "slug," a closed section of tubing lowered into the water.

Slump — Downward slipping of a mass of rock or unconsolidated material moving as a unit

Solvent extraction/electrowinning — A method of separating a substance from a mixture, using a solvent to dissolve the desired material, leaving the unwanted substances. For these purposes, it is the process of extracting the copper from the ore leachate by an electrochemical process.

Special Status Species — Any species with a Federal, State, County, Forest Service, or any other special designation which identifies it as different from common species.

Sub-grade — Ore from which minerals cannot be extracted profitably with existing technology and under present economic conditions.

Subsidence — The sinking of a large part of the earth's crust; or the local sinking of the surface above mined-out workings.

Substrate — Materials of the streambed.

Succession — The progressive changes in plant communities toward climax.

Sulfide ore — Ore containing a binary compound of an element with sulfur.

Talus — An aggregation of fallen loose rock which forms at the base of a steep slope.

Tertiary — Period of earth history from 65 million to 2 million years ago and characterized by the proliferation of mammals.

Thrust Faulting — Low angle fracturing and differential displacement of bedrock in response to horizontal compressional stress within the earth's crust.

Total Dissolved Solids (TDS) — Total amount of dissolved material, organic or inorganic, contained in a sample of water.

Transmissivity — The rate at which water is transmitted through a unit width of a groundwater aquifer or confining bed under a unit hydraulic gradient.

Tuff — A rock formed of compacted volcanic fragments, generally smaller than 4 millimeters in diameter.

Uplift — Elevation of an extensive area of the earth's surface in relation to other areas

Vadose Zone — The layer of surficial earth materials that is beneath the surface but above the permanent groundwater level.

Variety Class — a particular level of visual variety or diversity of landscape character. There are three variety classes; A,B, and C.

Variety Class A — distinctive

Variety Class B — common

Variety Class C — minimal

Visual Resource Management classes (VRM) — Classification of landscapes according to the kinds of structures and changes that are acceptable to meet established visual goals (BLM designation).

Visual Quality Objective (VQO) — A desired level of excellence based on physical and sociological characteristics of an area. Refers to degree of acceptable alteration of the characteristic landscape.

Visual Resource — The composite of basic terrain, geologic features, water features, vegetation patterns, and land use effects that typify a land unit and influence the visual appeal the unit may have for viewers.

Volatile organic compound — A carbon-containing compound which evaporates rapidly.

Waste Rock — Non-ore rock that is extracted to gain access to ore. It contains no ore metals or contains them at levels below the economic cutoff value, and must be removed to recover the economic ore.

Waters of the United States — A jurisdictional term from Section 404 of the Clean Water Act referring to waterbodies such as lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation, or destruction of which could affect interstate or foreign commerce.

Watershed — all of the land that drains surface water to a given stream above a designated point (usually its mouth); also called a stream drainage or drainage basin.

Wetlands — Areas that are inundated by surface or groundwater with a frequency sufficient to support and under normal circumstances does or would support a prevalence of vegetation or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction.

Zero Discharge — A facility that does not discharge water off-site to surface drainages, but rather, reuses water in facility processes, unless discharges are in conformance with NPDES permit limits.